intech mariner 90

VHF/FM MARINE

RADIOTELEPHONE

SERVICE MANUAL

intech
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1. GENERAL INFORMATION.

1.1 Introduction.

The Intech Mariner 90 system is comprised of the Mariner 90, Mariner 90R and Mariner 9. The Mariner 90 is the basic transceiver. The Mariner 90R is a Mariner 90 with circuitry added to interface easily with the full function remote unit, Mariner 9.

The Mariner 90/90R is described in Sections I - V. The Mariner 9 is described in Section VI.

1.2 Specifications.

Specifications for the Intech Mariner 90/90R transceiver are listed in Table 1.

1.3 List of Channels.

The complete list of channels available (including the private channel option) is shown in Table 2.

1.4 Available Options.

The following options are available for the Mariner 90.

- Mariner 9, Remote Control
- Mariner 10, Remote Control
- 10 Private Channels
- H177, Handset
- Floating Ground
- R08 Ringer
- PROM

1.4.1 Mariner 9, Remote Control.

The Mariner 9 remote control is described in the Mariner 9 Owner's and Installation Manual and in Section VI of this manual.

NOTE: The Mariner 9 will only function with the Mariner 90R as the main unit.

TABLE I. SPECIFICATIONS

Receiver

Sensitivity	0.3μV for 12dB SINAD
Squelch Threshold	0.3μV
Adjacent Channel Rejection	70dB
Spurious Rejection	70dB
Current Drain	0.8A
Audio Power Output	4W @ 10% Distortion
IF Frequencies	16.9 MHz and 446.25 KHz
Input Impedance	50Ω

Transmitter

RF Output Impedance	50Ω
RF Output Level	< 1 watt or 25 watts
Spurious Output	70dB below carrier
Frequency Stability	±5ppm
Deviation	+5 KHz
Duty Cycle	100% Continuous

General

Size	3.5"H x 10.75"W x 12"D
Weight	5.5 lbs/2.5 kgs
Frequency Range	155.500 to 163.575 MHz, Receive 155.500 to 158.975 MHz, Transmit
Input Voltage	13.6V DC nominal, ±15%, negative ground
Channel Spacing	25 KHz
Type Accepted	FCC Part 81, 83 Canadian RSS 182 C,L,V - T.A.#237 821 223
Operating Temperature Range	-20 to +50°C

M90 SYSTEM

VHF/FM MARINE CHANNELS

TABLE 2

Channel	Receive Frequency		Local Oscillator Frequency		Transmit Frequency
	U.S.	INT.	U.S.	INT.	
0	162.575	162.575	145.675	145.675	--------
1	162.550	162.550	145.650	145.650	--------
2	162.400	162.400	145.500	145.500	--------
3	162.475	162.475	145.575	145.575	--------
4	157.050	161.650	140.150	144.750	--------
5	162.425	162.425	145.525	145.525	--------
6	162.450	162.450	145.550	145.550	--------
7	162.500	162.500	145.600	145.600	--------
8	162.525	162.525	145.625	145.625	--------
9	162.375	162.375	145.475	145.475	--------
00	156.000	156.000	139.100	139.100	156.000*
01	156.050	160.650	139.150	143.750	156.050
02	160.700	160.700	143.800	143.800	156.100
03	160.750	160.750	143.850	143.850	156.150
04	160.800	160.800	143.900	143.900	156.200
05	156.250	160.850	139.350	143.950	156.250
06	156.300	156.300	139.400	139.400	156.300
07	156.350	160.950	139.450	144.050	156.350
08	156.400	156.400	139.500	139.500	156.400
09	156.450	156.450	139.550	139.550	156.450
10	156.500	156.500	139.600	139.600	156.500
11	156.550	156.550	139.650	139.650	156.550
12	156.600	156.600	139.700	139.700	156.600
13	156.650	156.650	139.750	139.750	156.650
14	156.700	156.700	139.800	139.800	156.700
15	156.750	156.750	139.850	139.850	156.750*
16	156.800	156.800	139.900	139.900	156.800
17	156.850	156.850	139.950	139.950	156.850
18	156.900	161.500	140.000	144.600	156.900
19	156.950	161.550	140.050	144.650	156.950

* Transmit Inhibited

VHF/FM MARINE CHANNELS

TABLE 2

Channel	Receive Frequency		Local Oscillator Frequency		Transmit Frequency
	U.S.	INT.	U.S.	INT.	
20	161.600	161.600	144.700	144.700	157.000
21	157.050	161.650	140.150	144.750	157.050
22	157.100	161.700	140.200	144.800	157.100
23	157.150	161.750	140.250	144.850	157.150
24	161.800	161.800	144.900	144.900	157.200
25	161.850	161.850	144.950	144.950	157.250
26	161.900	161.900	145.000	145.000	157.300
27	161.950	161.950	145.050	145.050	157.350
28	162.000	162.000	145.100	145.100	157.400
29	157.450	162.050	140.550	145.150	157.450*
30	157.500	162.100	140.600	145.200	157.500*
31	157.550	162.150	140.650	145.250	157.550*
32	157.600	162.200	140.700	145.300	157.600*
33	157.650	162.250	140.750	145.350	157.650*
34	157.700	162.300	140.800	145.400	157.700*
35	157.750	162.350	140.850	145.450	157.750*
36	162.400	162.400	145.500	145.500	157.800*
37	162.450	162.450	145.550	145.550	157.850*
38	162.500	162.500	145.600	145.600	157.900*
39	162.550	162.550	145.650	145.650	157.950*
40	158.000	162.600	141.100	145.700	158.000*
41	158.050	162.650	141.150	145.750	158.050*
42	158.100	162.700	141.200	145.800	158.100*
43	158.150	162.750	141.250	145.850	158.150*
44	158.200	162.800	141.300	145.900	158.200*
45	158.250	162.850	141.350	145.950	158.250*
46	158.300	162.900	141.400	146.000	158.300*
47	158.350	162.950	141.450	146.050	158.350*
48	158.400	163.000	141.500	146.100	158.400*
49	158.450	163.050	141.550	146.150	158.450*

* Transmit Inhibited

M90 SYSTEM

VHF/FM MARINE CHANNELS

TABLE 2

Channel	Receive Frequency		Local Oscillator Frequency		Transmit Frequency
	U.S.	INT.	U.S.	INT.	
50	158.500	163.100	141.600	146.200	158.500*
51	158.550	163.150	141.650	146.250	158.550*
52	158.600	163.200	141.700	146.300	158.600*
53	158.650	163.250	141.750	146.350	158.650*
54	158.700	163.300	141.800	146.400	158.700*
55	158.750	163.350	141.850	146.450	158.750*
56	158.800	163.400	141.900	146.500	158.800*
57	158.850	163.450	141.950	146.550	158.850*
58	158.900	163.500	142.000	146.600	158.900*
59	158.950	163.550	142.050	146.650	158.950*
60	160.625	160.625	143.725	143.725	156.025
61	160.675	160.675	143.775	143.775	156.075
62	160.725	160.725	143.825	143.825	156.125
63	156.175	160.775	139.275	143.875	156.175
64	160.825	160.825	143.925	143.925	156.225
65	156.275	160.875	139.375	143.975	156.275
66	156.325	160.925	139.425	144.025	156.325
67	156.375	156.375	139.475	139.475	156.375
68	156.425	156.425	139.525	139.525	156.425
69	156.475	156.475	139.575	139.575	156.475
70	156.525	156.525	139.625	139.625	156.525
71	156.575	156.575	139.675	139.675	156.575
72	156.625	156.625	139.725	139.725	156.625
73	156.675	156.675	139.775	139.775	156.675
74	156.725	156.725	139.825	139.825	156.725
75	156.775	156.775	139.875	139.875	156.775*
76	156.825	156.825	139.925	139.925	156.825*
77	156.875	156.875	139.975	139.975	156.875
78	156.925	161.525	140.025	144.625	156.925
79	156.975	161.575	140.075	144.675	156.975

* Transmit Inhibited

M90 SYSTEM

VHF/FM MARINE CHANNELS

TABLE 2

Channel	Receive Frequency		Local Oscillator Frequency		Transmit Frequency
	U.S.	INT.	U.S.	INT.	
80	157.025	161.625	140.125	144.725	157.025
81	161.675	161.675	144.775	144.775	157.075
82	161.725	161.725	144.825	144.825	157.125
83	157.175	161.775	140.275	144.875	157.175
84	161.825	161.825	144.925	144.925	157.225
85	161.875	161.875	144.975	144.975	157.275
86	161.925	161.925	145.025	145.025	157.325
87	161.975	161.975	145.075	145.075	157.375
88	157.425	162.025	140.525	145.125	157.425
89	157.475	162.075	140.575	145.175	156.475*
90	157.525	162.125	140.625	145.225	157.525*
91	157.575	162.175	140.675	145.275	157.575*
92	157.625	162.225	140.725	145.325	157.625*
93	157.675	162.275	140.775	145.375	157.675*
94	157.725	162.325	140.825	145.425	157.725*
95	162.375	162.375	145.475	145.475	157.775*
96	162.425	162.425	145.525	145.525	157.825*
97	162.475	162.475	145.575	145.575	157.925*
98	162.525	162.525	145.625	145.625	157.925*
99	162.575	162.575	145.675	145.675	157.975*

* Transmit Inhibited

M90 SYSTEM
OPTIONAL
VHF/FM MARINE CHANNELS

TABLE 2

Channel	Receive Frequency		Local Oscillator Frequency		Transmit Frequency
	SIMPLEX	SEMI-DUPLEX	SIMPLEX	SEMI-DUPLEX	
A01	155.500	160.100	138.600	143.200	155.500
A02	155.525	160.125	138.625	143.225	155.525
A03	155.550	160.150	138.650	143.250	155.550
A04	155.575	160.175	138.675	143.275	155.575
A05	155.600	160.200	138.700	143.300	155.600
A06	155.625	160.225	138.725	143.325	155.625
A07	155.650	160.250	138.750	143.350	155.650
A08	155.675	160.275	138.775	143.375	155.675
A09	155.700	160.300	138.800	143.400	155.700
A10	155.725	160.325	138.825	143.425	155.725
A11	155.750	160.350	138.850	143.450	155.750
A12	155.775	160.375	138.875	143.475	155.775
A13	155.800	160.400	138.900	143.500	155.800
A14	155.825	160.425	138.925	143.525	155.825
A15	155.850	160.450	138.950	143.550	155.850
A16	155.875	160.475	138.975	143.575	155.875
A17	155.900	160.500	139.000	143.600	155.900
A18	155.925	160.525	139.025	143.625	155.925
A19	155.950	160.550	139.050	143.650	155.950
A20	155.975	160.575	139.075	143.675	155.975

* These channels can be assessed through the P-channel board (A6), or through the keyboard when used with a customized PROM.

M90 SYSTEM
OPTIONAL
VHF/FM MARINE CHANNELS

TABLE 2

Channel	Receive Frequency		Local Oscillator Frequency		Transmit Frequency
	SIMPLEX	SEMI-DUPLEX	SIMPLEX	SEMI-DUPLEX	
A21	158.025	162.625	141.125	145.725	158.025
A22	158.075	162.675	141.175	145.775	158.075
A23	158.125	162.725	141.225	145.825	158.125
A24	158.175	162.775	141.275	145.875	158.175
A25	158.225	162.825	141.325	145.925	158.225
A26	158.275	162.875	141.375	145.975	158.275
A27	158.325	162.925	141.425	146.025	158.325
A28	158.375	162.975	141.475	146.075	158.375
A29	158.425	163.025	141.525	146.125	158.425
A30	158.475	163.075	141.575	156.175	158.475
A31	158.525	163.125	141.625	156.225	158.525
A32	158.575	163.175	141.675	146.275	158.575
A33	158.625	163.225	141.725	146.325	158.625
A34	158.675	163.275	141.775	146.375	158.675
A35	158.725	163.325	141.825	146.425	158.725
A36	158.775	163.375	141.875	146.475	158.775
A37	158.825	163.425	141.925	146.525	158.825
A38	158.875	163.475	141.975	146.575	158.875
A39	158.925	163.525	142.025	146.625	158.925
A40	158.975	163.575	142.075	146.675	158.975

* These channels can be assessed through the P-channel board (A6), or through the keyboard when used with an customized PROM.

1.4.2 Mariner 10, Remote Control.

The Mariner 10 remote control is described in the Mariner 10 Owner's and Installation Manual. The Mariner 10 can be used with the Mariner 90 as well as the Mariner 90R although the installation procedure is different.

Mariner 90:

Figure 1 shows how the Mariner 10 control cable is connected inside the Mariner 90.

1. Connect MIC HI on Mariner 90, A4 to MIC HI from Mariner 10.
2. Connect MIC PTT on Mariner 90, A4 to PTT from Mariner 10.
3. Connect MIC SHIELD on Mariner 90, A4 to MIC LO from Mariner 10.
4. Connect B+ on Mariner 90, A2 to B+ from Mariner 10.
5. Connect PWR IND on Mariner 90, A2 to TX LIGHT from Mariner 10.
6. Connect DISC on Mariner 90, A3 to AUDIO HI from Mariner 10.
7. Connect GND on Mariner 90, A3 to AUDIO LO from Mariner 10.

Mariner 90R:

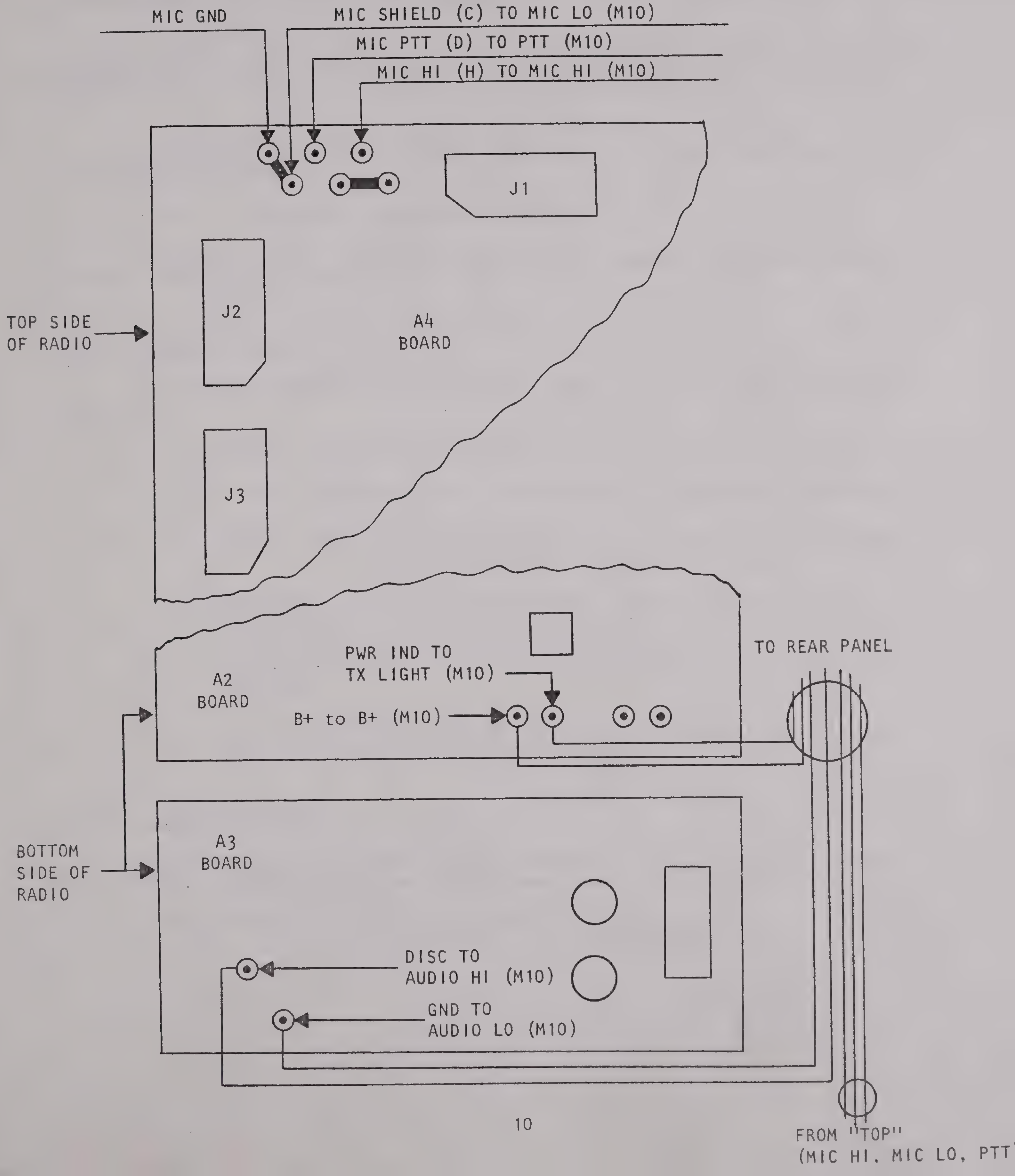
The Mariner 10 can be connected to the Mariner 90R using the Mariner 9 interconnect cabie if the following change is made.

1. Disconnect WHT/BLK wire from A4, pin AE (REMOTE PTT).
2. Cut off connector from this wire and strip wire to expose conductor.
3. Solder WHT/BLK wire to RED wire from microphone (MIC PTT).

This effectively parallels the PTT switch of the Mariner 90R and the Mariner 9.

FIGURE 1

MARINER 10 INSTALLATION



1.4.3 Private Channels.

CAUTION: Government regulations regarding the unauthorized use of private channels can involve severe penalties.

General description, channel programming and installation instructions of the private channel board, A6, have been included in the Owner's and Installation Manual. The theory of operation of the A6 board is described in Section 3.6.

Check out and troubleshooting information is given in Section IV, 4.2.5 and 4.3.5 respectively.

List of components is shown in Section V, 5.6.

Figures 16 and 17 show the schematic and component locations, respectively of the private channel, A6.

1.4.4 H177, Handset.

Connection information for the H177 handset is given below. (See also Figure 2.)

1. Connect red wire from H177 to MIC PTT (D) terminal on A4 board.

2. Connect shield from H177 to MIC SHIELD (C) terminal on A4 board.

3. Connect white wire from H177 to MIC HI (H) terminal on A4 board for M90 and to MIC (F) terminal on A4 board for M90R.

4. Disconnect yellow wire from A3 board, SPKR terminal. Remove ferrite core. Reroute yellow wire so that it follows the main harness on the bottom side to the A4 board on the top side of the M90/90R. Solder yellow wire to the green wire on H177 and insulate.

5. Add wire from black wire on H177 to SPKR connector on A3 board. Route the wire along the main wire harness.

1.4.5 Floating Ground.

The floating ground modification provides for "grounding" of the case of the Mariner 90/90R without causing the power supply to be "grounded".

The modifications necessary are shown in Figure 3.

FIGURE 2
H177 HANDSET

M90/90R
TOP VIEW

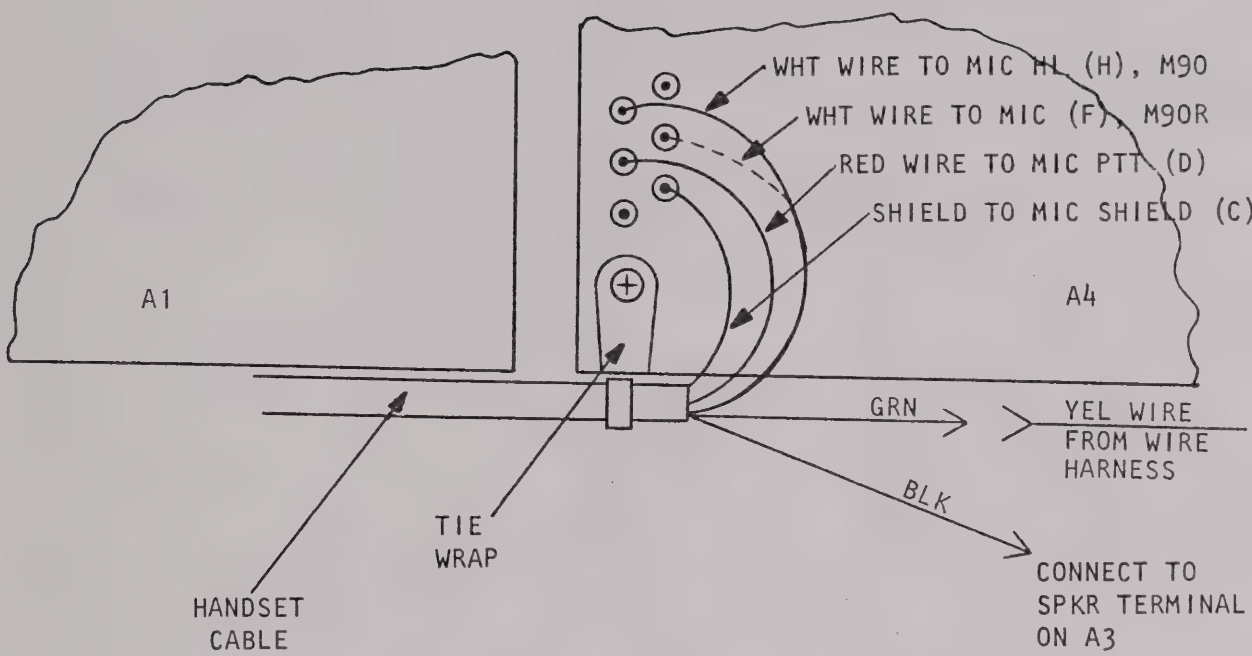
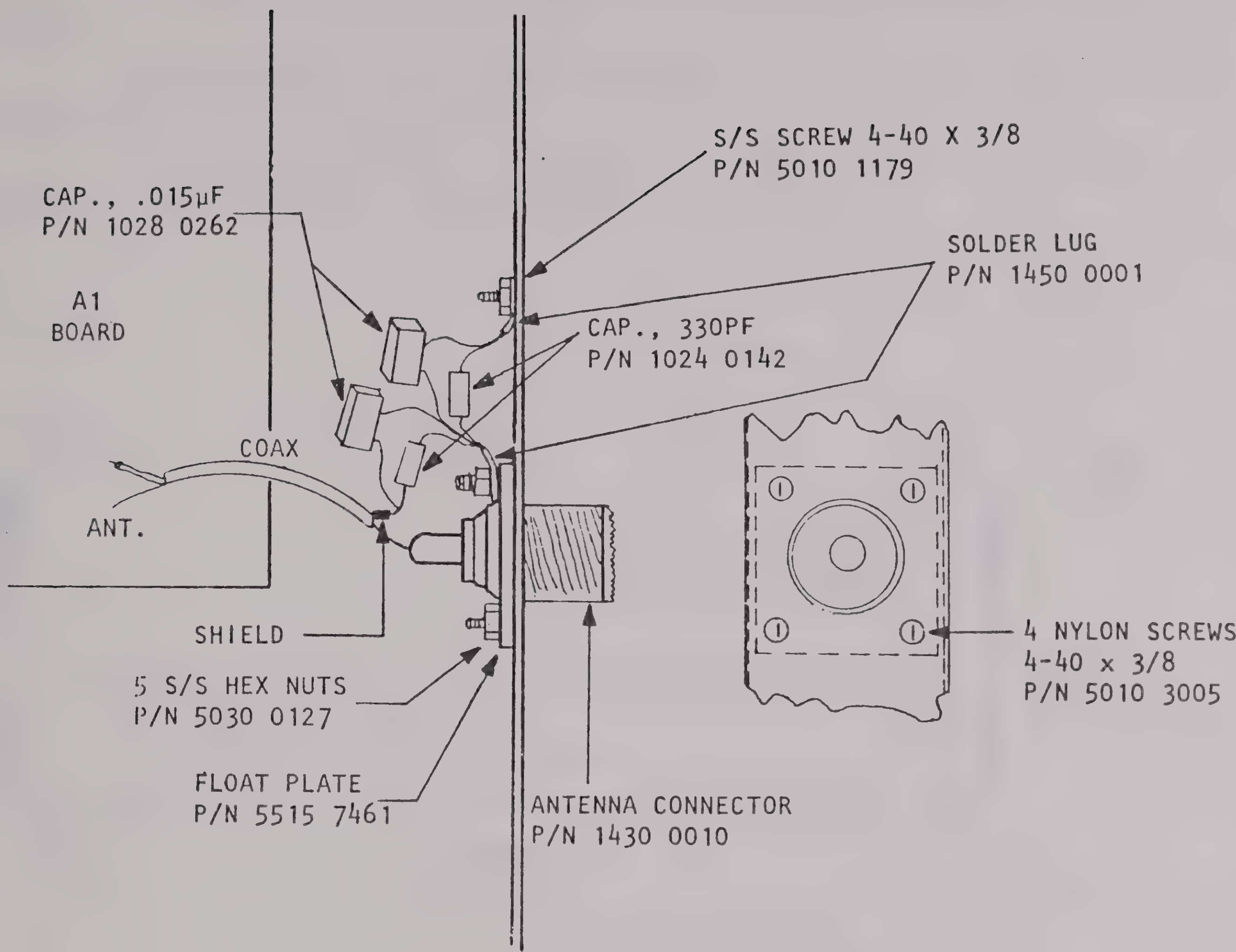
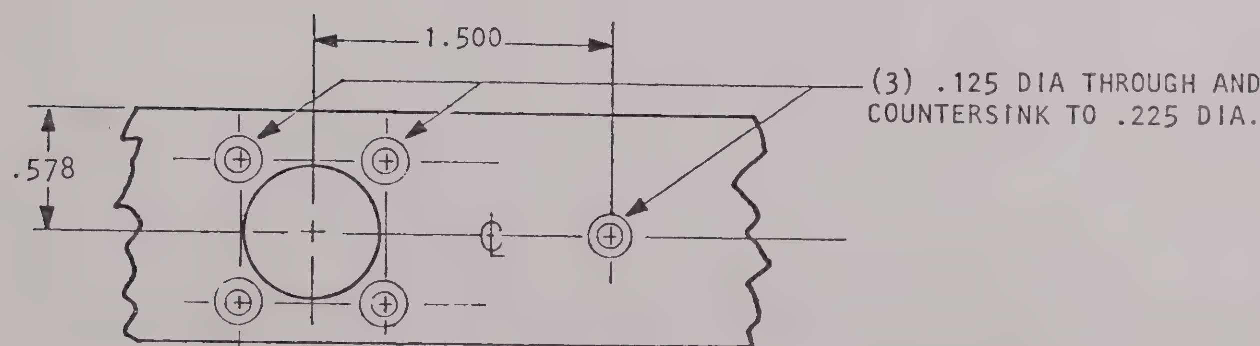


FIGURE 3
FLOATING GROUND



REAR CHASSIS MODIFICATION

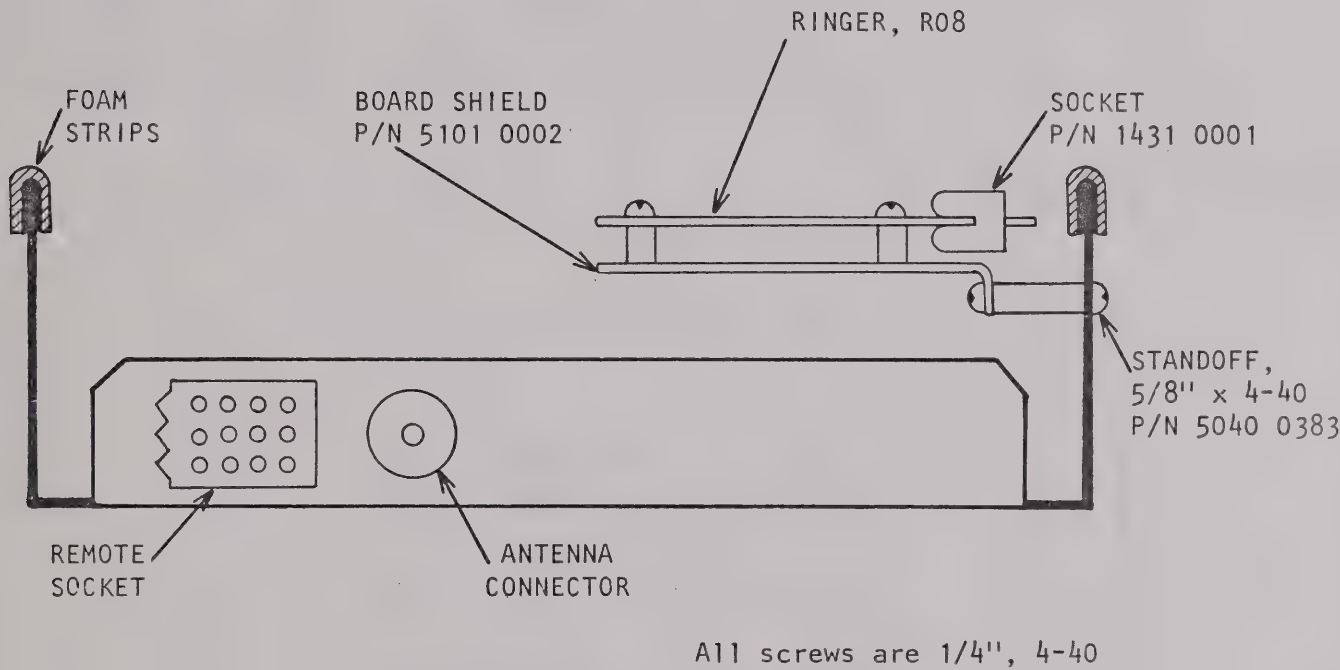


1.4.6 Ringer R08.

The R08 ringer can be used with the M90/90R when installed as shown below.

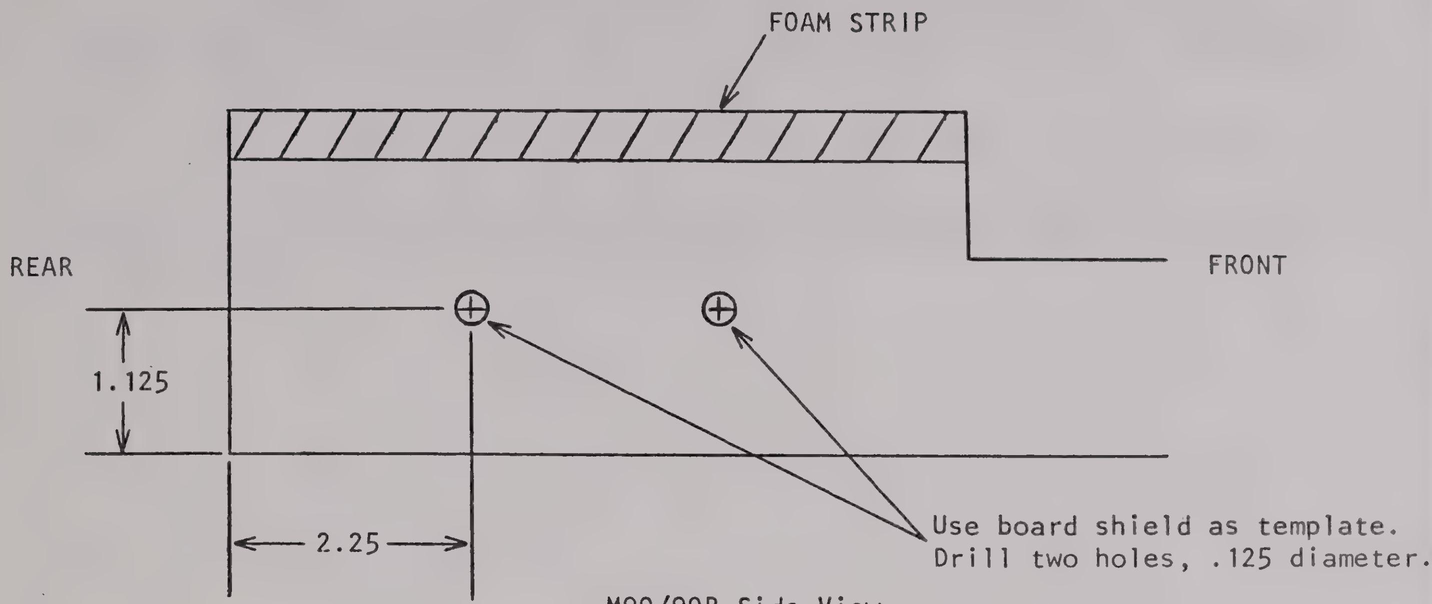
In the M90/90R, the Tx power light will flash and a tone heard in the loudspeaker if a call is received.

In the Mariner 9 (ringer installed in the M90R), the Tx power light will flash but no tone will be heard if a call is received.



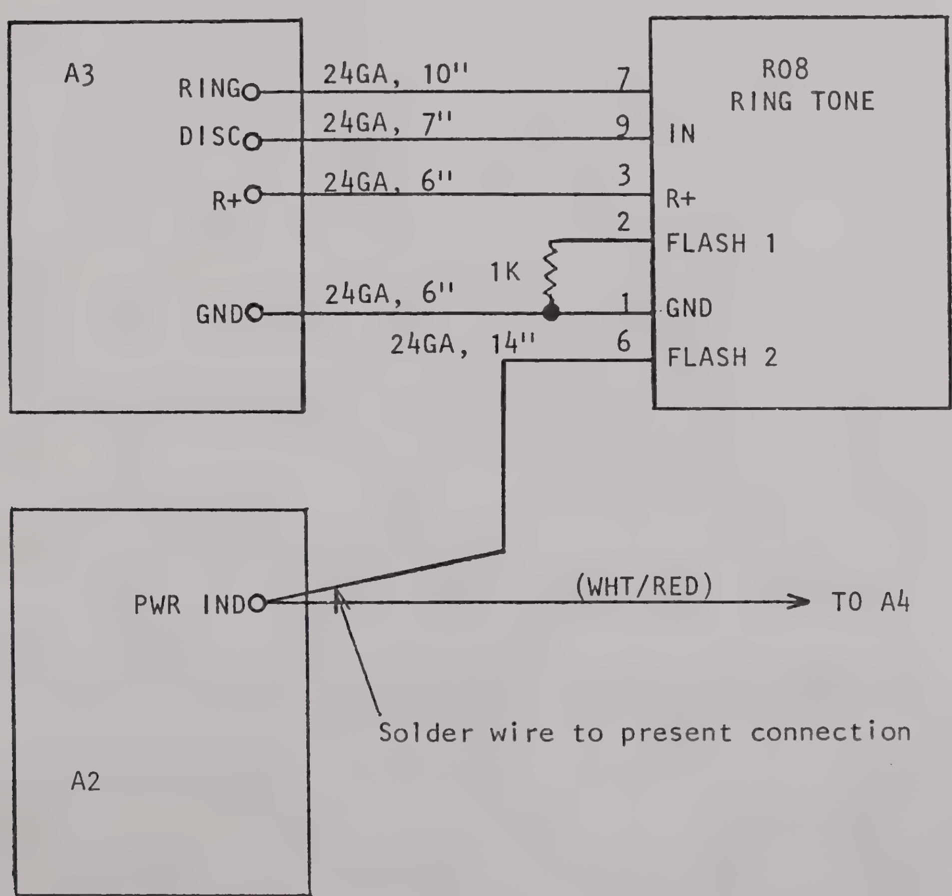
M90/90R REAR VIEW

Mount the standoffs as shown below.



M90/90R Side View

Install wires and 1K resistor as shown below.



1.4.7 PROM.

Channel status information like S/D, hi/lo power, Tx OK/not OK and channel accessibility is determined by a PROM, U1 on the A4 board. The M90/90R is delivered with a "standard" PROM, P/N 2860 0233.

Custom PROMs are available from your Intech dealer or the factory.

An optional PROM, U3, permits the displayed channel number and the actual frequency to be changed to any desired combination within the permitted frequency band. Consult the factory for details.

2. PREPARING FOR USE.

CAUTION: All work performed on this radio set affecting the performance of the transmitter needs to be carried out by or under direct supervision of a technician holding at least a second class FCC radiotelephone license.

2.1 Installation.

Installation information for the Mariner 90/90R is given in the Owner's and Installation Manual.

2.2 Power and Speaker Connections.

Figure 4 shows the power plug with speaker connection.

Power Connection. The power leads may be connected directly to a 12 volt negative ground battery supply or to a terminal strip located adjacent to the transceiver. To ensure proper installation, proceed as follows.

- Turn the volume control knob fully counterclockwise to the OFF position.
- Connect the power cable to the power source. Attach the red wire in the cable to the positive (+) side and the black wire to the negative (-) side of the power source.
- Connect the power cable to the 12V DC connector on the rear panel of the transceiver.

If the installation requires additional power cable length, consult your Intech dealer for the proper size to use.

Speaker Connections.

- Internal Speaker. The unit is shipped from the factory with the internal speaker connected through a loop between pins 2 and 5 on the power plug. No change is needed unless you wish to hook-up an external speaker.
- External Speaker Only. To hook-up an external speaker, cut the loop between pins 2 and 5. Connect an external speaker between pins 1 and 2. A black wire is provided on pin 1 to facilitate the hook-up. Impedance of speaker should not be less than 3 ohms.
- External Speaker in Parallel with Internal Speaker. When connecting an external speaker in parallel with the internal speaker, use a speaker with 16 ohm or higher impedance. Connect as for external speaker only - except do not cut the loop between pins 2 and 5.

PLUG'S VIEW

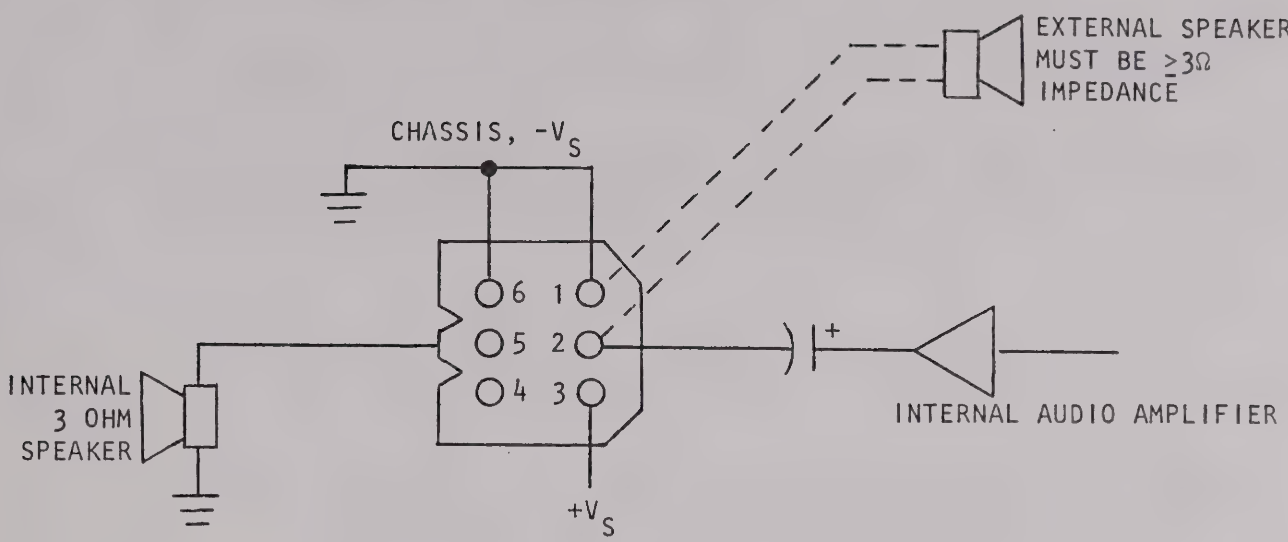


FIGURE 4

POWER PLUG AND SPEAKER CONNECTIONS

2.3 Check Out.

After the unit has been installed and connected to a suitable antenna, it should be checked to ensure that it is operating properly. However, before attempting to operate the set, carefully study the operating instructions provided in the Owner's and Installation Manual. Then check operation of the Mariner 90/90R.

- Check the fuse located on the rear panel.
- Turn the volume control knob clockwise to power ON position.
- Select an inactive channel.
- Turn squelch control knob fully clockwise and then counterclockwise until receiver noise through the loudspeaker stops.
- Select a weather channel or other known operating channel and check that reception is clear and undisturbed.
- Load a few channels into the scan memory and check the scan function.
- Check priority scan and traffic search.

- Select an active transmit channel. Key the microphone and check the TX PWR light in HI and LO power.

- Select a local public correspondence channel. Call marine operator and ask for a radio check.

- If private channels have been installed, check that the display shows the correct private channel entered. For example, if private channel P3 has been "loaded", check as follows:

  First press P
  then press 3
  then press E (enter)

  DISPLAY MUST SHOW P3

  NOTE: If the private channel option has not been installed (A6 board) or if a private channel has not been programmed into the private channel board, the display will show $\boxed{\text{PE}}$ (private channel empty) for approximately 1 second - then return to previous selected channel.

- If the private channel is programmed for transmit, also check TX PWR light by keying microphone - in high as well as low power.

- If Mariner 9 or Mariner 10 remote control has been installed, check operation of the system by selecting a local public correspondence channel on the Mariner 90/90R. Call marine operator from the Mariner 9 or Mariner 10 and ask for a radio check.

- When using the H177 handset instead of the standard microphone, perform check by calling marine operator for a radio check.

- Also verify that audio is transferred from the H177 handset to the Mariner 90/90R when the handset is returned to the cradle.

- Check a floating ground system by measuring resistance between antenna connector and chassis (negative supply) to assure that no connection exists between the two.

3. THEORY OF OPERATION.

3.1 Introduction.

Operation of the Mariner 90/90R VHF/FM Marine Radiotelephone is illustrated by the block diagram, Figure 5.

Basically, the set consists of a transmitter, receiver and a phase locked loop synthesizer. One crystal is used as a reference for all receive, local oscillator and transmit frequencies. Channels are entered with a 4 x 4 keyboard. A microprocessor performs the logic and programming functions.

The receiver uses the double conversion superheterodyne principle with a dual gate MOS FET as an RF amplifier. Front end selectivity is obtained with a double tuned circuit and another double tuned circuit connects the RF amplifier to the first mixer. Low side injection is used.

A six-pole crystal filter at 16.9 MHz constitutes the main selectivity. The IF signal is amplified before being mixed down to 446.25 KHz in the second mixer. The second L.O. is crystal controlled at 17.34625 MHz.

The second IF amplifier/demodulator consists of one I.C. The demodulator is a quadrature detector that demodulates FM while rejecting AM.

A squelch circuit surpresses the noise in the absence of a carrier. The audio amplifier is an I.C. that produces more than 4 watts of audio.

The transmitter is all solid-state construction, including the power output stage. The power output stage is fully protected against damage due to faulty antenna connections including open or short circuits. A light emitting diode (LED) provides positive RF indication. Phase modulation is employed, in a circuit which is not sensitive to frequency changes, thereby providing the same consistent modulation on each channel. The microphone amplifier includes limiting and filtering circuits which provide constant modulation over a wide range of microphone input levels with roll-off to comply with FCC specifications.

The receive first local oscillator signal and the final transmit signal is generated by a synthesizer. Channel selection is done by keyboard. Keyboard information is processed by a microprocessor that controls the synthesizer. One of the keys selects between the U.S. and International receive mode (simplex/duplex) where such operation is customary; e.g., Channel 22. Two seven-segment LED displays are used to indicate the channel number. The VCO operates on the final L.O. frequency, which is divided down to a 25 KHz reference frequency by a high speed programmable divider. The 25 KHz reference frequency is derived from a 3.2 MHz crystal - the only frequency determining device in the transceiver.

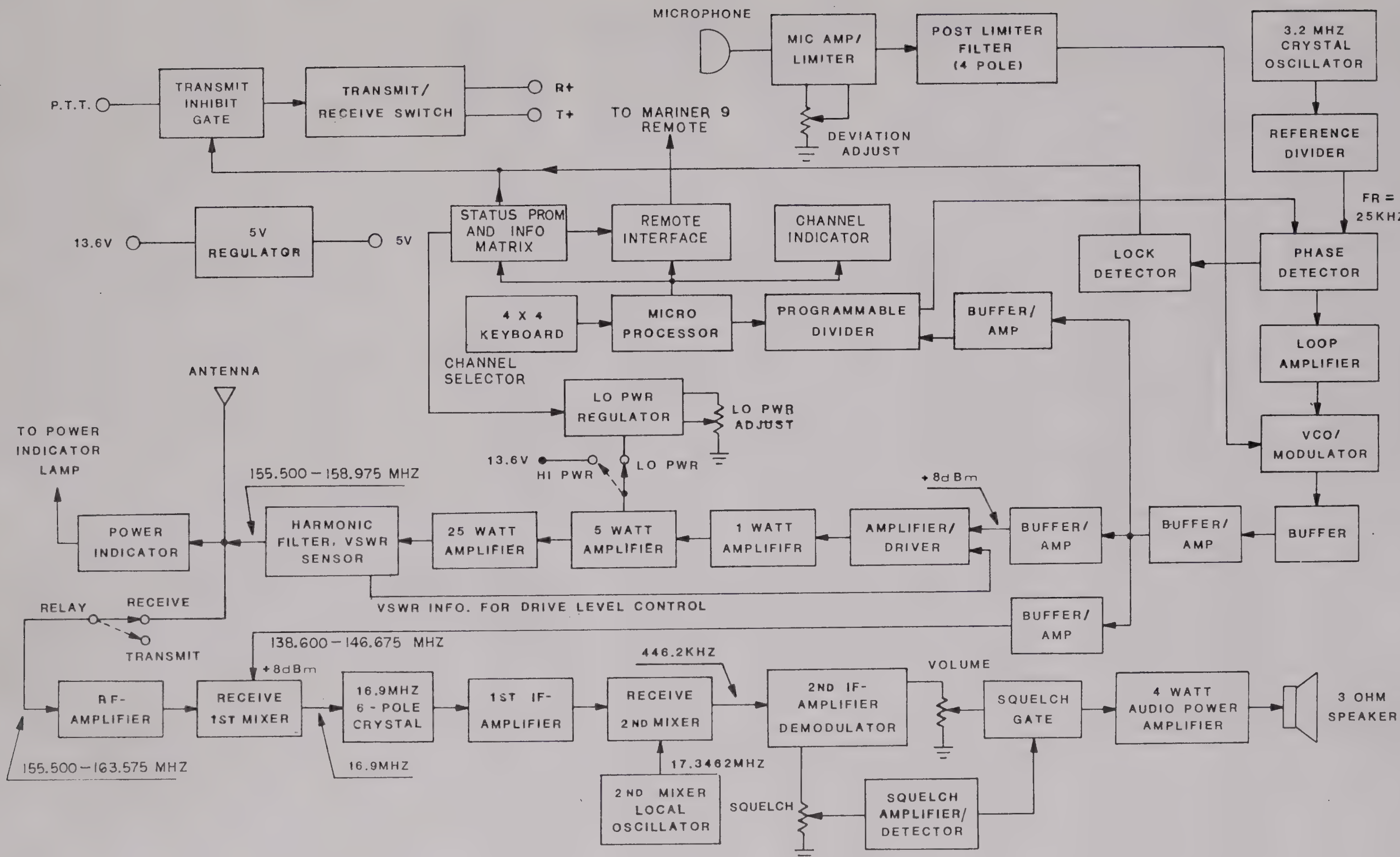


FIGURE 5

MARINER 90 BLOCK DIAGRAM

3.2 Receiver (A3).

The receiver (A3) is a double conversion superheterodyne receiver designed for narrow-band FM reception in the frequency range of 155.50 to 163.75 MHz. A schematic of the receiver is shown in Figure 10. Figure 11 shows the component location on the A3 P.C. board.

The input signal is amplified by a single RF stage (Q1) and applied to the first mixer (Q2) where it is heterodyned with the local oscillator output from the synthesizer (A1, Rx Lo), and thereby converted to the first I.F. of 16.9 MHz.

The 16.9 MHz signal is filtered by the 6-pole crystal filter to provide good adjacent channel rejection. The signal is amplified by an integrated circuit I.F. amplifier (U1). U1 also acts as a mixer, subtracting the first I.F. signal (16.9 MHz) from the second local oscillator signal (17.34625 MHz) resulting in a second I.F. frequency of 455.25 KHz. The second I.F. signal is amplified, limited, and demodulated by the second I.F. amplifier/demodulator (U2).

The second I.F. amplifier/demodulator output is then passed through a de-emphasis network, R22 and C44, which provides for a 6dB/octave roll-off beginning at approximately 300 Hz. De-emphasis reduces the noise on weak signals, and componsates for pre-emphasis in the transmitter audio circuit. The audio signal is then amplified by audio amplifier U3 to the rated 4 watts output.

A noise-actuated squelch circuit is included to silence the receiver when no carrier is present. This is accomplished by passing the noise component of the demodulator output through a high pass filter (Q5) which eliminates any voice audio frequencies, leaving only noise. The filter output is amplified (Q6) and detected (CR1/CR2) to produce a DC voltage. This DC voltage is then applied to the squelch gate (Q9) causing it to turn on.

With the squelch gate turned on, the input to the audio power amplifier is inhibited, preventing noise from reaching the speaker. When a carrier is received, the noise component decreases due to the quieting action of the receiver, causing the squelch gate to be turned off so that the signal can reach the audio amplifier.

3.3 TRANSMITTER (A2).

The transmitter (A2) is designed for narrow-band FM (phase modulated) transmission in the frequency range of 155.500 to 158.975 MHz. A schematic of the transmitter is shown in Figure 8. Figure 9 shows the component location on the A2 P.C. board.

The output signal from the synthesizer (A1, Tx output) is applied to the RF input of the transmitter.

The RF input signal is amplified in 2 stages (Q7, Q8) with each stage followed by bandpass filtering. The amplified signal is then coupled to a 1W pre-driver (Q9), a 5W driver (Q10), and to a 25W final power amplifier (Q11) before passing through a three section harmonic filter. The harmonic filter removes any unwanted harmonics and leaves only the desired carrier. Printed circuit coils are used to improve stability.

The transmitter is protected by a VSWR sensing circuit (L9, CR7). The circuit is adjusted by R23 to reduce the drive to the A2 power amplifier board in the event that the VSWR exceeds 2:1 (P_F = 25W, P_R = 2.8W) on high power. Reduction of drive input signal is performed by Q6.

Transmit/receive switching (Q1, Q2) is located on the transmitter (A2) board also. When PTT information (microphone keyed, transmit = ground) is received, T+ voltage is routed to the appropriate circuitry and the transmitter is activated. Releasing the microphone key caused T+ to disappear and R+ is now routed to the appropriate circuitry causing the receiver to be activated and the antenna relay contact (K1) to be closed.

Power indication is derived by rectifying (CR6) RF from the final power amplifier (Q11). The rectified DC voltage is amplified (Q3/Q4) to provide drive signal for the power indicating circuitry.

3.4 Frequency Synthesizer (A1).

The frequency synthesizer (A1) provides the receive first local oscillator signal and the final transmit signal. In addition, the complete microphone amplifier, limiter and filter and the modulator are located on the synthesizer (A1) board.

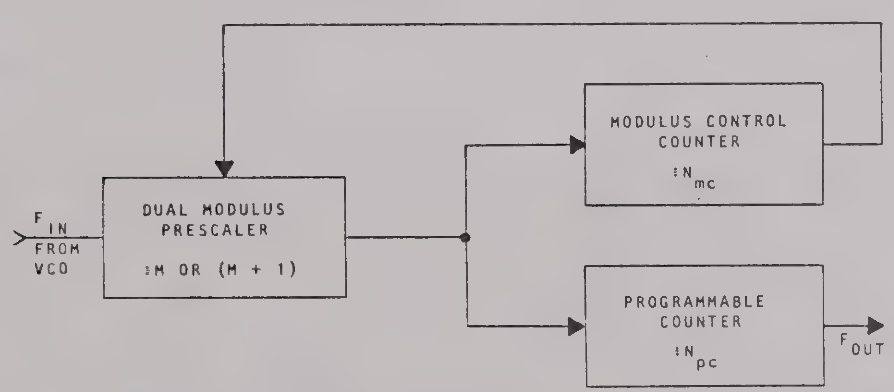
A block diagram of the frequency synthesizer is shown in Figure 6. Figure 7 shows the schematic and Figure 8 the component location on the A1 board.

The voltage controlled oscillator or VCO (Q2) operates on the final receive local oscillator frequency and the final transmit frequency. The frequency is varied by a DC voltage (approximately 2.5 - 7.5V DC) applied to a varicap diode (CR2).

Frequency coverage is divided into two bands. The complete receive local oscillator frequency band from 138.600 to 146.675 MHz is covered with CR1 conducting (Q1 on). The transmit frequency band of 155.500 to 158.975 MHz is covered with CR1 not conducting. Switching between receive local oscillator and transmit bands is accomplished by Q1 from PTT information (U10, U13).

The VCO signal is extensively buffered (Q3, Q4) then split into three separate isolated signals that are routed to the receiver (A3), transmitter (A2) and to the programmable divider (P/O A1) respectively. The programmable divider is a high speed ECL/TTL counter with a dual modulus prescaler. The principle of a dual modulus prescaler is shown below:

COUNTER WITH DUAL MODULUS PRESCALER



The dual modulus prescaler is controlled by a modulus control counter that causes it to alternate between $\div M$ or $\div (M + 1)$. Operation is best explained by assuming that all three counters have been set for the beginning of a cycle; the prescaler for division by $(M + 1)$, the modulus control counter for division by N_{mc}, and the programmable counter for division by N_{pc}. The prescaler will divide by $(M + 1)$ until the modulus control counter has counted down to zero; at this time, the all zero state is detected and causes the prescaler to divide by

M until the programmable counter has also counted down to zero. When this occurs, a cycle is complete and each counter is reset to its original modulus in readiness for the next cycle.

To determine the relationship between f_{out} and f_{in}, let T_1 be the time required for the modulus control counter to reach its terminal count and let T_2 be the remainder of one cycle. That is, T_2 is the time between terminal count in the modulus control counter and terminal count in the programmable counter. When the modulus control counter reaches zero, N_{mc} pulses will have entered it at a rate given by $f_{in}/(M + 1)$ pulses/second or T_1 is:

$$T_1 = \frac{(M + 1)}{f_{in}} \cdot N_{mc}$$

At this time, N_{mc} pulses have also entered the programmable counter and it will reach its terminal count after $(N_{pc} - N_{mc})$ more pulses have entered. The rate of entry is now f_{in}/M pulses/second since the prescaler is now dividing by M. From this T_2 is given by:

$$T_2 = \frac{M}{f_{in}} \cdot (N_{pc} - N_{mc})$$

Since $f = \frac{1}{T}$:

$$f_{out} = \frac{1}{T_{total}} = \frac{1}{T_1 + T_2} = \frac{1}{\frac{(M + 1)N_{mc}}{f_{in}} + \frac{M(N_{pc} - N_{mc})}{f_{in}}}$$

$$f_{out} = \frac{f_{in}}{(M + 1)N_{mc} + M(N_{pc} - N_{mc})}$$

$$= \frac{f_{in}}{MN_{mc} + N_{mc} + MN_{pc} - MN_{mc}}$$

$$= \frac{f_{in}}{MN_{pc} + N_{mc}}$$

In the frequency synthesizer, the dual modulus prescaler is a combination of two dividers (U3/U4) that together form a ÷30/÷31 prescaler. The modulus control counter and the programmable counter are both made up of two low power schottky dividers (U7/U8 and U11/U12 respectively).

The programmable counter (U11/U12) is programmed to divide by three distinct division ratios only:

Receive simplex:	÷184
Receive duplex:	÷190
Transmit:	÷206

Programming information is derived from simplex/duplex and PTT signals appropriately gated (U10, U13).

The modulus control counter (U7/U8) is programmed by information from the microprocessor (Q5) (Synthesizer code, Table III, M90 Owner's Manual) to which is added a fixed number (offset):

MODE	OFFSET
Receive simplex	0
Receive duplex	4
Transmit	16

In summary, between the three modes of operation, receive simplex, duplex and transmit, the following changes occur in the programmable divider:

MODE CHANGE	PROGRAMMABLE COUNTER (U11/U12)	MODULUS CONTROL COUNTER (U7/U8)
Simplex to Duplex	From ÷184 to ÷190	From ÷NμP to ÷(NμP + 4)
Simplex to Transmit	From ÷184 to ÷206	From ÷NμP to ÷(NμP + 16)
Duplex to Transmit	From ÷190 to ÷206	From ÷(NμP + 4) to ÷(NμP + 16)

where NμP is the division ratio (decimal notation) corresponding to the binary synthesizer code from Table III.

The resulting output from the programmable divider is applied to the signal input of the phase detector (U14) where it is compared in frequency and phase to a 25 KHz reference signal. The 25 KHz reference signal is derived from a 3.2 MHz stable crystal oscillator (Q8) after division by 128 in a two stage divider (U15/U16).

If a frequency difference exists between the programmable divider output and the 25 KHz reference, the lock detector output (LOCK INFO, J1-10) will go positive. The lock information is routed to the interface board (A4).

If the reference frequency and the output frequency of the programmable divider is identical, 25 KHz, the phase detector will output a control voltage ($\Phi 2$) that is proportional to the phase difference between the two signals. The system is in lock.

The phase detector output is routed to the loop amplifier (U18). From the loop amplifier it passes two low pass filter sections (R42/C44 and R2/C6) before being applied to the diode CR2.

To understand the operation of the complete phase locked loop system, assume a channel has been selected and the loop is in lock. When entering another channel on the keyboard, the following takes place:

- The synthesizer code changes to reflect the new channel.
- The programmable counter (U11/U12) and the modulus control counter (U7/U8) may or may not change division ratio dependent on whether or not a mode change takes place (simplex to duplex, etc.).
- Because of the changed divider ratio in the programmable divider, a frequency difference will exist between the output of the programmable divider and the reference frequency of 25 KHz.
- At the phase detector output ($\Phi 2$) the voltage will change in accordance with the difference frequency (beat note).
- After passing the loop amplifier (U18) and low pass filtering, the voltage change will be applied to CR2 thus changing the frequency of the VCO (Q9).
- The VCO frequency will change until no frequency difference exists between the programmable divider output and the reference frequency of 25 KHz.
- The loop will lock and the channel selection has been completed.

When transmitting, the microphone audio signal is applied to the microphone amplifier/limiter (U17). From there, the signal passes through a low pass filter (R59/C70) and a potentiometer (R60) that serves to adjust the deviation.

A 3-pole low pass filter (Q11) makes up the post limiter filter. From this filter, the microphone signal is applied to the modulator (CR6).

3.5 Display and Interface Circuit (A5, A4).

The display and interface circuit (A5, A4) controls all keyboard functions, the channel indicator, the front panel lights and the frequency synthesizer.

Schematics of the display and interface circuitry are shown in Figures 13 and 15. Figures 14 and 16 show the component locations.

The majority of the control functions are performed by a microprocessor (U1, Figure 15). The microprocessor controls synthesizer code, channel number and other display information, key tone, and dimming.

Control input to the microprocessor is a 4 x 4 keyboard. Channel number and other display information is routed to BCD to 7 segment dividers (U3 and U4) that drives the LED display (U5 and U6).

- TONE:

  The tone output from the microprocessor (square wave) is filtered in low pass filter U8A, U8B before being routed to the A3 board as a sine wave. Some change in the volume can be done by changing R10. (Reduce R10 to reduce tone volume. Do not reduce R10 below 330 ohms.)

- DIMMING:

  Dimming is performed by alternately displaying the channel number and blanking the display as part of the microprocessor program.

  To dim the front panel lights, dimming information is derived from the "units" display in U2A and applied to the front panel LED driver U7A, B, C, D thus alternately switching the front panel LED on and off.

  The display and front panel light brightness is determined by the on to off ratio.

- STATUS INFO:

  Channel status information (simplex/duplex, hi/lo power) and channel accessibility are determined by a PROM (U1) on the A4 board (Figure 13).

  Custom PROMs are available from your Intech dealer or the factory.

  An optional PROM, U3, permits the displayed channel number and the actual frequency to be changed to any desired combination within the permitted frequency band. Consult the factory for details.

- LOW POWER:

When selecting the low power mode, the supply voltage to the 5 watt driver on the A2 board (Q10, Hi/Lo Pwr Remote), see Figure 9, is derived from an emitter follower on the A4 board. By adjusting the base voltage (Q7), the low power can be adjusted to 1 watt or less.

If the PROM, U1, is programmed for low power on a particular channel, the PROM output (D7, pin 13) is a low voltage ($\leq$.3V) that will turn off Q4 and thereby turn off Q5. With Q5 turned off, Q6 is also turned off and the supply voltage to the 5 watt driver, Q10, on the A2 board is determined by Q7.

- PTT/TX INHIBIT:

PTT and transmit inhibit circuitry is comprised of Q4, U5, Q9, and Q10.

To key the transmitter, Q9 and Q10 must be turned on. Lock information from the A1 board determines if Q10 is conducting or not. If the synthesizer is in lock, a low voltage level is applied to U5F causing the output of U5F to go high (>3V) and turn on Q10. All other transmit inhibit information is combined in U4. If any input to A4 is high voltage, the output of A4 will be a low level, causing Q9 to be turned off.

In order to turn on Q9 and key the transmitter (assume Q10 is turned on) <u>all</u> inputs to U4 must be low. Thus, the microphone must be keyed and all transmit inhibit information from the microprocessor (A5) and the PROM (U1) must be low.

- START-UP:

Q11, C8, R26 and CR11 make up the start-up circuit. This circuit is only important if a Mariner 9 remote is connected. The start-up circuit delays the microprocessor "turn-on" routine to make sure that the Mariner 90R will be in control after supply voltage is applied to the system.

- INITIALIZATION:

The initialization circuitry is comprised of U2 and a diode matrix (internal information matrix). (See Owner's and Installation Manual for details on programming this matrix.)

During "turn-on", the microprocessor will "interrogate" this matrix to determine which modes of operation (scan, search, etc.) are permitted and which scan speed and squelch drop out time to select.

3.6 Private Channels (A6).

The private channel (P-channel) option adds 10 channels (P0-P9) to the number of channels available in the Mariner 90/90R. Because a coding matrix is used, any channel listed in Table 2 can be programmed - in any mode: simplex, duplex, transmit high power, transmit low power, and no transmit.

A schematic of the private channel (A6) is shown in Figure 16. Figure 17 shows the component locations.

The operation of the private channel (A6) is most easily understood by considering it as a switch. In normal mode, all control signals from the microprocessor (A5) are routed directly through to the interface (A4). If a P-channel is selected, the microprocessor (A5) outputs a control signal on synthesizer code bits 6 and 7 and a channel number (0-9) on bits 0-3. Then it interrogates bit 4 to see if a channel has been programmed in the coding matrix (ϕ = 1). If a P-channel has been programmed into the matrix, no further change takes place. The control signal on bits 6 and 7 will switch the data selectors (U1, U2, U5) to output information from the coding matrix instead of from the microprocessor (A5).

Synthesizer code bits 0-3 control the private channel number by selecting one of 10 lines on the BCD to decimal decoder (U4). Upon selecting a specific line, synthesizer code information (data selector U1 and U2) and mode information (data selector U5) is routed to the interface (A4).

Hi/lo power information is fed to a switching circuit (Q1-3) that overrides the front panel Hi/lo power switch.

If the particular private channel is empty (ϕ = 0), the microprocessor returns control to itself.

3.7 Remote Control Interface (A7).

The remote control interface (A7) provides switching and driving circuitry necessary to interface with the remote cable and the Mariner 9.

- SUPPLY VOLTAGE:

  Supply voltage is controlled by the relay K1 so that supply voltage can be turned on in either the main unit (Mariner 90R) or the remote unit (Mariner 9).

- REMOTE LIGHT, HI/LO POWER:

  U1 controls the remote light (decimal point) and hi/lo power upon signals from the microprocessor. After the Mariner 90R $\boxed{E}$ key has been activated, the output of U1B will be low indicating that the Mariner 90R is in control. This turns off the remote light (see Figure 15) and permits high or low power to be selected by the hi/lo power switch (S2) in the Mariner 90R. If a signal from the microprocessor indicates that control has been taken by the remote unit (Mariner 9), the output of U1B is high. This causes the remote light to be turned on in the Mariner 90R - indicating that the Mariner 90R has lost control - and also causes the output of U1C to go low so that the Mariner 90R hi/lo power switch (S2) is disabled. Hi/lo power is now controlled from the remote unit (Mariner 9) through pin 4 on the remote socket.

- DATA BUS:

  Control data between the main and the remote unit runs on a single wire data bus (pin 10 on the remote socket). Q1 and Q2 comprise the line driver for data out to the remote unit. U3 receives the data from the remote unit and routes it to the microprocessor.

- TX/RX AUDIO AND INTERCOM:

  Transmit audio signals from the microphone in the Mariner 90R are buffered in the Tx audio/intercom driver, U4. The audio signal is superimposed upon a DC voltage that is controlled by the output of U2A. When the MIC PTT input to U2A is low (mic keyed), the output of U2A is high and the output of U4 is approximately 6V. When U4 goes high, Q3 will turn on and the squelch will be activated (A3 board, see Figure 11) which in turn prevents audio output (feedback) from the speaker. The priority switch, Q4, will also turn on to inform the microprocessor that the microphone key has been activated.

  When the microphone key is released, the output of U2A returns to a low voltage. The DC output level of U4 is now determined by the voltage divider R25/R9 (10:1). With a 13.6 volt supply voltage, the output of U4 is approximately 1.36V.

3.7 --Continued.

It is important to note, that the information transmitted from the Mariner 90R to the Mariner 9 on wire number 1 (intercom hi) is only important as far as the DC level is concerned while both audio and DC is important in transmission from the Mariner 9 to the Mariner 90R.

The audio signal on wire number 1 (intercom hi) from both the Mariner 90R and the Mariner 9 is fed to the A4 board (pin H) and further to the microphone amplifier on the A1 board to modulate the transmitted carrier. The audio signals are also amplified and buffered in U5 and routed to the Mariner 9 (wire number 7). Thus, wire number 7 carries the audio signal from the Mariner 90R to the Mariner 9 as "sidetone" so that both sides can be heard in a transmission.

Wire number 1 carries the audio signal from the Mariner 9 to the Mariner 90R. However, in this case the audio signal is the actual modulating signal and after amplification in U5 it is routed to the squelch and volume pot as "sidetone".

When transmitting, it is necessary to mute the "sidetone". U2B will turn on Q5 to clamp the sidetone signal when the microphone is keyed.

The intercom clamp, Q6, serves the purpose of eliminating receiver noise while using the intercom function. While the remote station (Mariner 9) is talking, the Mariner 90R is in the receive mode and if the squelch control is left open, noise would be heard. Q6 clamps the discriminator output (A3, Figure 11).

4. MAINTENANCE.

4.1 Recommended Test Equipment.

Instrument	Manufacturer and Model Number
Signal Generator	Cushmann CE3
Sinadder	Helper Instrument Co.
Wattmeter	Bird 43 and 25W Plug-In
Dummy Load	Termaline 8130
FM Deviation Meter	McGraw Edison 920
Frequency Counter	Hewlett-Packard, HP 5382A
Oscilloscope	Hewlett-Packard, HP 1707B
Multimeter	Simpson 260
Power Supply	Trygon HR20-10B

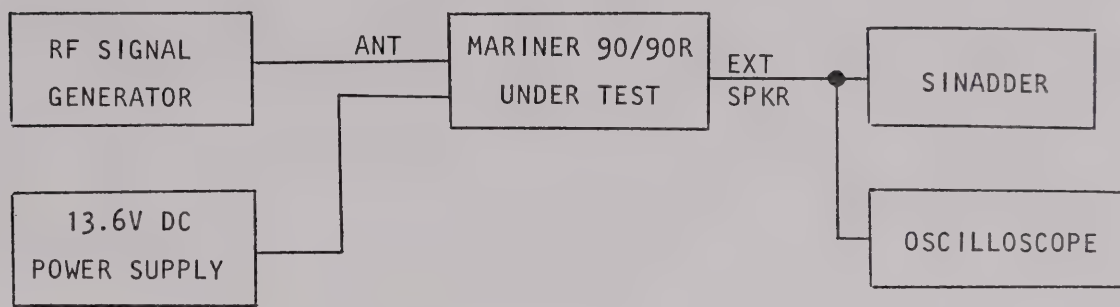
4.2 General Check Out Procedure.

Before starting a check out of the Mariner 90/90R, adjust the controls as follows:

Connect power supply:	13.6V DC negative ground
Hi/lo power switch:	low power
Squelch:	fully clockwise
Volume:	mid-range
Channel:	any convenient channel
Remote control:	disconnected

4.2.1 Receiver Check.

To check the operation of the receiver, connect test equipment as shown:



1. With RF signal generator output turned completely down, adjust receiver volume control for a convenient noise output level.

2. Set RF signal generator on frequency and modulate with a 1 KHz signal and a deviation of ±3.3 KHz.

3. Set the RF signal generator output level to 0.4 microvolts. The 1 KHz tone should be clearly audible and the sinadder should indicate a sinad ratio of approximately 12dB.

4. Repeat these tests on several channels.

5. Turn RF signal generator output completely down.

6. Turn squelch control counterclockwise until noise disappears. Increase RF signal generator output until the 1 KHz tone is audible. Signal generator output should be less than the value measured above for 12dB sinad.

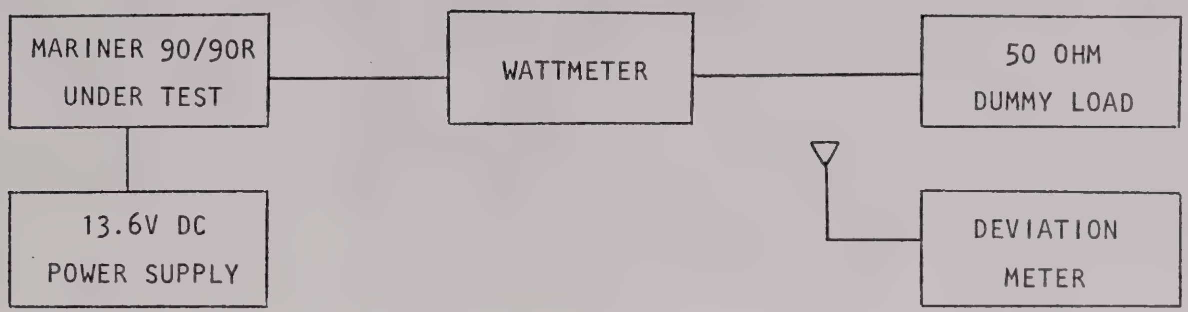
7. Increase RF signal generator output level to 1mV and adjust volume control for clearly audible signal (1 KHz).

8. Observe the audio output on the oscilloscope. The audio signal should be free of obvious distortion.

9 Increase volume until clipping of the audio signal is observed. The clipping should be fairly symmetrical and the output level ≥8V p-p.

4.2.2 Transmitter Check.

To check the operation of the transmitter, connect test equipment as shown:



1. Set the RF power switch to hi power. Observe power output on wattmeter and check for reflected power. With 13.6V, power out should be more than 22.5 watts with less than 1 watt reflected. At 10.0V, the power out should be greater than 10 watts.

2. Observe deviation by whistling into microphone. Maximum deviation must be less than 5 KHz. If necessary, retune with R60, A1 board.

3. Set RF power switch to lo position and check power output. Output must be less than 1 watt. If necessary, return with R15, A4 board.

4. Check VSWR protection as follows:

    - Open Circuit. Disconnect the 50 ohm dummy antenna and key the transmitter. Measure the current to the transceiver. It should not exceed 3.5 amps. If necessary, adjust for 3.5 amps with R23, A2 board.

    - Short Circuit. Short the antenna output using a short piece of wire. Key the transmitter and monitor the supply current to check that it is about 3.5 amps.

      Connect the 50 ohm dummy antenna. Check that the power is between 22.5 watts and 25 watts. The power indicator light should go on.

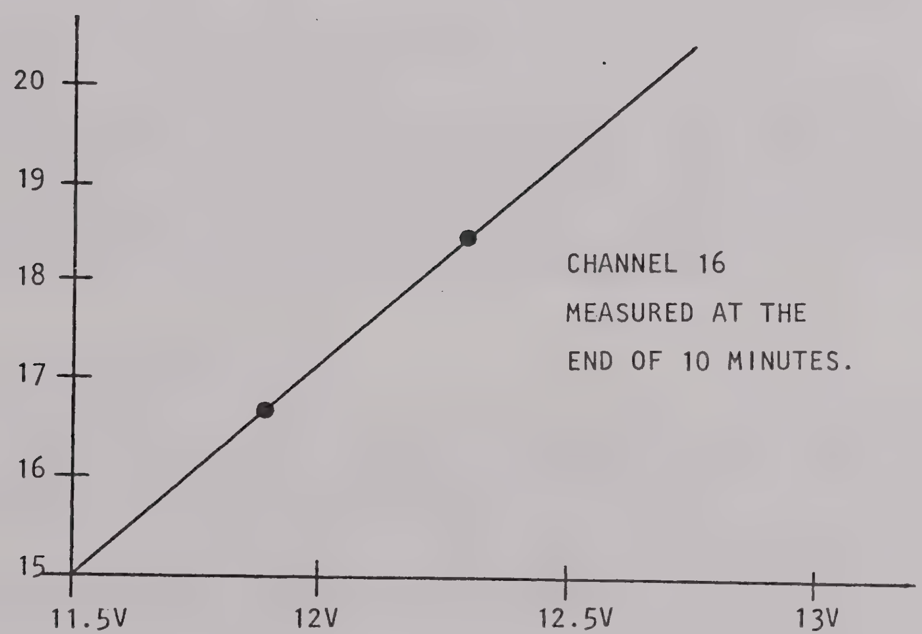
      The VSWR circuit is not activated in low power. An open or short in that condition will not damage the final transistors.

4.2.2 --Continued.

5. Check for "Party Board" (Part III, title III, 83.518) performance as follows:

- Measure the primary voltage at the power input terminals of the transceiver. While connected to the battery ONLY, it shall be not less than 11.5 volts.

- Key the transmitter on Channel 16 into a wattmeter and matching dummy load. At the end of 10 minutes, measure the voltage at the power input terminals to the radio set. In the graph below, find the corresponding output power. The power indicated by the wattmeter has to be equal or greater.



4.2.3 Frequency Synthesizer Check.

To check the operation of the frequency synthesizer, proceed as follows:

1. Set up as in 4.2.2, transmitter check.

2. Remove cover from frequency synthesizer (A1).

3. Connect the frequency counter to either Rx LO output or Tx output on the A1 board (any one of the two coax cables).

4. Connect a voltmeter to TP3 on the A1 board.

   NOTE: The voltmeter must have an input resistance of 1 mega ohm or higher.

5. Select the channel with the highest receive frequency. Measure that LO frequency is correct per Table 2. If not, return with C46.

6. Check that TP3 voltage is $\leq$7.5V DC.

4.2.4 Display and Interface Circuitry Check.

Checking display and interface circuitry, consists essentially of checking that keyboard information is correctly processed, e.g. the correct channel is selected, mode is correct, display and lights are correct. This check can be performed by measuring frequency as in 4.2.3 and compare - for a number of different channels - with the values from Table 2 in addition to performing the various keyboard entries described in the Owner's and Installation Manual.

4.2.5 Private Channel Check.

Checking the private channel programming and operation can be performed by measuring frequency as in 4.2.3 to verify that private channel transmit and receive frequencies are correct in accordance to programming.

Performing the display and interface circuit check per 4.2.4, assures that all direct connections on the A6 board are checked.

4.2.6 Remote Control Interface Check.

To check the remote control interface, a Mariner 9 remote unit is needed. By operating the Mariner 90R with the Mariner 9, the complete system is checked. The operating procedure for the Mariner 90R and the Mariner 9 is described in the Mariner 90R and the Mariner 9 Owner's Manual.

4.3 Troubleshooting Procedure.

The following information is helpful to troubleshoot the Mariner 90/90R transceiver. Before tuning or adjusting anything, check the DC voltages and signal levels in the area in question. Under no circumstances attempt to tune a "dead" radio; problems will only be compounded.

As a general rule, look for the obvious problems first. For example, make sure that supply voltages are present on all boards. Also check for loose or frayed wires, etc.

4.3.1 System Troubleshooting.

When problems are found in the complete system - transceiver, antenna and power source - after the transceiver itself checks out good "on the bench", the problem can usually be traced down to the power source or the antenna system.

The antenna system is checked with a wattmeter. Connect the wattmeter between the antenna connector and the coax cable to the antenna. Measure the forward power and reflected power. The VSWR must be less than 2:1 for proper operation. Greater VSWR ratios will cause the transmitter VSWR protection circuit to automatically reduce the transmit power. If the VSWR is 2:1 or greater, check the antenna, coax cable, and coax connector.

If the power output is less than the specified 25 watts, first check the battery voltage, <u>at the radio</u>, in transmit. The radio is factory set to 25 watts at 13.6V input. The power output drops with the battery voltage drop. Although the radio will function down to 10.5V, a voltage of less than 11.5V will impare performance. If the voltage is low, check the boat electrical system, wiring, charging system, and cable length.

4.3.2 Receiver Troubleshooting.

Problems in the receiver (A3) can be located using the test points. Test point locations are shown in Figures 11 and 12. Test point values are shown below. All DC readings are taken with a multimeter or DVM with at least 20,000 ohms/volt input resistance and are ±20%.

If a problem occurs, check all voltages in the area in question. For a "dead" receiver, some preliminary checks are helpful. The audio amplifier (U3) can be checked by injecting a 1 KHz at 1V p-p signal into the "RING" input and observe it at the loudspeaker terminal. The gain is about 0.4V/V in the squelched mode.

4.3.2 --Continued.

In the unsquelched mode, noise is present at the "high" side of the volume and squelch potentiometer. With the squelch pot completely counterclockwise, there is about 3V p-p noise at the collector of Q6. Squelching the receiver results in Q8 collector going high, therefore Q9 turns on and shorts the input of U3 to ground.

Marginal sensitivity is almost always due to RF amp (Q1) or mixer (Q2) problems. The local oscillator level will also affect the sensitivity slightly and should measure +2 to +10dBm. The retuning of L1 through L4 should be done only with a sweep generator. Channels 00, 59, 60, and 59I can be used to check the sensitivity on the band edges. If these channels are not accessible, use the highest and the lowest receive frequency.

Bad sensitivity can also be caused by a faulty antenna relay. Check the antenna relay on the A2 board by jumping the reed contacts (not the coil) with a clip lead.

A really "sick" receiver (>20μV sensitivity) is usually due to IF problems. The sensitivity is determined by injecting 16.9000 MHz (AC coupled) into the LO IN port and measure SINAD at the loudspeaker terminal. The sensitivity should be 2 to 8 microvolts for 12dB SINAD.

If the sensitivity is poor, check the 2nd L.O., 17.3462 MHz, at Q3 emitter with an oscilloscope. This signal should be about 2.0V p-p. Any gross failures in the I.C.s will show up on the DC voltages. With 1mV rms of 16.9 MHz injected into "LO IN", the first IF output (U1, pin 10) should show a 16.9 MHz waveform approximately 1.6V p-p. The balanced mixer output (U1, pin 14) should show 446.25 KHz at 3V p-p. Audio output at the "DISC" terminal (squelch hi) should be approximately 0.8V p-p for 3.3 KHz deviation.

To tune the IF amplifier proceed as follows:

Inject 16.9000 MHz into the "LO IN" pot using AC coupling. Modulate with a 1 KHz tone at 3.3 KHz deviation. Set the signal generator for a noisy signal and tune L5 and C35 for maximum audio ("VOL" pin). Increase the level to approximately 1mV rms and adjust C39 for best sinewave (lowest distortion). The resulting IF sensitivity should be 2 to 8μV for 12dB SINAD.

RECEIVER, A3

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
A	R+	13.5V DC
B	Q1, Gate 2	6.5V DC
C	Q1, Source	1.2V DC
D	Q2, Gate 1	0.35V DC
E	Q2, Source	0.55V DC
F	Q3, Collector	12.1V DC
G	U1, Input Bias	1.4V DC, Pin 6
H	U1, Det Ref	3.5V DC, Pin 2
I	U1, V_{Reg}	7.8V DC, Pin 13
J	U2, Input Bias	1.4V DC, Pin 6
K	U2, Det Ref	3.5V DC, Pin 2
L	U2, V_{Reg}	7.8V DC, Pin 13
M	U2, Det Out	3.8V DC, Pin 1 (depends on C39 setting)
N	Squelch Filter	3.3V DC
O	Squelch Amp	4.2V DC, no squelch (CW)
P	Noise Detector	0V, unsquelched (CW) 3V, max. squelch noise (CW)
Q	Squelch DC Amp	0V, unsquelched 9.2V, squelched
R	U3, Bias	6.8V DC, Pin 7
S	B+	13.6V DC
T	U3, Output	6.8V DC, Pin 12

4.3.3 Transmitter Troubleshooting.

Before tuning or repairing the A2 board, some precautions must be observed.

- Do not transmit in high power without a 50 ohm load. If the VSWR protection is wrongly adjusted, the RF output transistor may burn out.

- Do not transmit in high power with the A2 board removed from the chassis or without tightening the unit to the chassis with the power transistor studs. The heat sinking is necessary.

- Do not tune for absolute maximum power output. The typical radio will produce 35 watts at 13.6V DC. If the transceiver draws more than 6A at 13.6V DC, it is not tuned correctly and damage to the final may occur.

- If new RF transistors are needed, use Intech parts. There are substantial differences between manufacturers of allegedly identical transistors.

- The trimmer capacitors are polarized (stator and rotor). The arrow on the capacitor must match the arrow on the assembly drawing.

- Do not tune a "dead" radio. Find the problem first, then tune. If a gross mistuning has caused zero power output, preset the trimmers as on page 42.

4.3.3 --Continued.

Problems in the transmitter (A2) can be located using the test points. Test point locations are shown in Figures 9 and 10. Test point values are shown on page 43.

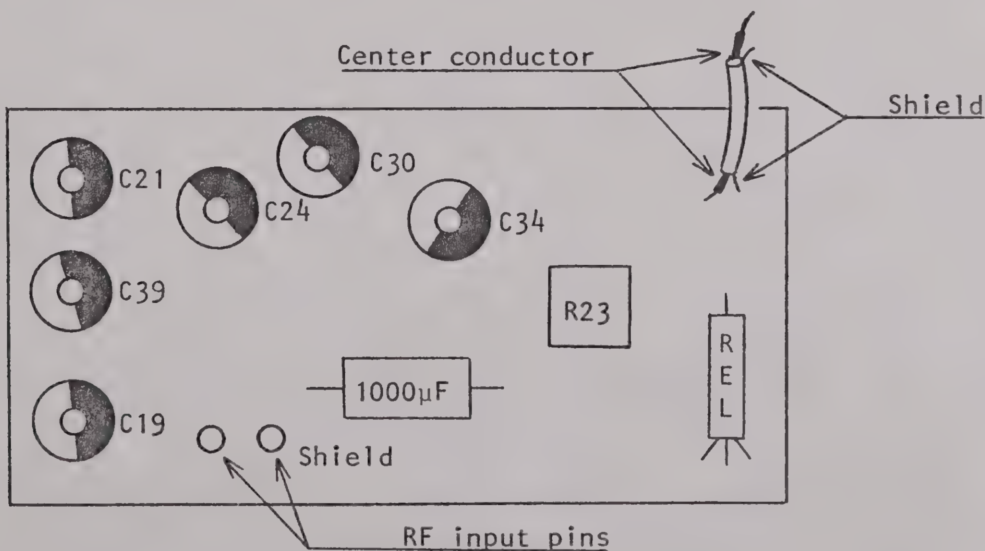
Initially, it must be determined if the problem is on the A1 or A2 board. Disconnect the coax cable from the A1 board and inject a signal, +2 to +10dBm (300 to 700mV rms) at 156.8 MHz, into the RF input and key the transmitter. If 25 watts appears, the problem is on the A1; if not, the A2. Check the voltages at the transmit/receive switch in low power and with the RF input, from the A1 board, disconnected.

Tuning is required if RF parts have been replaced or the symptoms point to an A2 problem. First turn R23 fully counterclockwise. This disables the VSWR circuit. Set the transceiver to a high channel (e.g., CH28). Connect a wattmeter and dummy load to the antenna jack. Set a regulated power supply to 10.5V. Preset the trimmers as shown below - then tune all trimmers for maximum power output on the wattmeter. The power output should be approximately 10 watts at a supply voltage of 10.5V.

Set the supply voltage to 13.6V. Adjust C34 for 25 watts. The supply current should be less than 5 amps at 13.6V DC. Vary the voltage between 10.5 volts and 15.5 volts DC. The output power should change smoothly.

Set the power supply to 13.6V DC. Set R23 approximately half way. Disconnect the dummy load. Key the transceiver and set R23 to 3.5A power supply current. Short the antenna connector. Current should be less than 3.5A. Reset R23 if necessary. This completes the transmitter tuning.

If the VSWR protection circuit fails to operate (R23 has no effect), connect a VOM (not a DVM or VTVM) at the junction of CR7, C35, and R22. With a 50 ohm dummy load, the voltage should be less than 5V DC. With an open or shorted antenna, it should be approximately 10V DC for proper operation. Zero voltage indicates a defective CR7.



Preset position of trimmer on A2 board

TRANSMITTER, A2

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
B+	B+	13.6V DC
PTT	PTT	13.0V DC receive. Ground to transmit.
T+	Transmit Pwr.	13.6V DC transmit. 0V DC receive.
R+	Receive Pwr.	13.6V DC receive. 0V DC transmit.
Pwr Ind	Transmit Indicator	13.6V DC transmit. Open on receive. (NOTE: With Tx lamp disconnected, this point will "float" to 13.6V DC.)
A	VSWR TP	$\leq$5V, 50Ω antenna dummy load. $\geq$8V, Open or shorted antenna terminal.
B,C,D	PTT Circuit	Check with RF input from A1 board disconnected (no RF output). B 13.6V DC Rx 12.7V DC Tx C 6.6V DC Rx 12.8V DC Tx D 12.8V DC Rx 13.6V DC Tx
E	RF Indicator	Check in low power only. 13.6V DC Rx, 1V DC Tx.

4.3.4 Frequency Synthesizer Troubleshooting.

Problems in the synthesizer (A1) usually show up as wrong Tx or Rx frequencies or modulation problems. Since, however, the synthesizer is controlled by the microprocessor (A5), it is necessary first to determine if the correct synthesizer code is applied to the A1 board.

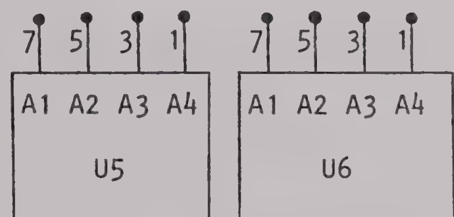
SYNTHESIZER CODE CHECK.

From Figure 6, it can be seen that 4 least significant bits (LSB) of the synthesizer code is applied to binary adder U5 and the 4 most significant bits (MSB) applied to binary adder U6. To check for correct synthesizer code, proceed as follows:

1. Select a channel.
2. Look up the synthesizer code for that channel in the Owner's and Installation Manual, Table II.
3. Check that the input code to U5 and U6 matches the selected synthesizer code as shown below.

Ex.: CH 16

	4 LSBs				4 MSBs			
Bit #:	0	1	2	3	4	5	6	7
CH 16 Synthesizer Code:	0	0	1	1	0	0	1	0
Pin #:	7	5	3	1	7	5	3	1



If the correct synthesizer code is present at the input to the binary adder (U5, U6), troubleshooting of the A1 board can proceed.

If the problem is wrong Tx or Rx frequency, the complete phase locked loop must be checked.

4.3.4 --Continued.

REFERENCE DIVIDER.

First measure all DC test point voltages to assure that the supply voltages are correct. Then observe the signal on test point S . If this signal is not present, check test point R . If the signal is correct on test point R the problem is U15/U16. If no signal or too low a signal level is observed on test point R , the 3.2 MHz crystal oscillator is faulty. If the correct 25 KHz reference signal is observed on test point S , check the signal on U15, pin 14. This signal must also be a 25 KHz signal but consist of narrow (2 μsec) pulses.

PROGRAMMABLE DIVIDER.

If the signal on U14, pin 14 is not present, the problem could be the programmable divider. Before further investigation of the programmable divider, it must be determined if the input signal to the programmable divider is correct. Check U3, pin 15. The signal level must be approximately OdBm (200mV). (WARNING: DC voltage is present on U3, pin 15. Make sure the voltmeter is AC coupled.) If the correct input level is observed, the programmable divider is faulty.

If the signal on U14, pin 14 is present but the wrong frequency is measured, it is necessary to measure the actual divider ratio before it can be determined if the problem is in the programmable divider. Proceed as follows:

1. Select a convenient channel.

2. Measure accurately the frequency at test point C or D and at U14, pin 14. Accuracy is very important.

3. Calculate the divider ratio by dividing the frequency measured at test point C or D with the frequency measured at U14, pin 14.

4. Calculate the actual divider ratio by dividing the correct frequency with 25 KHz.

If the divider ratios are not identical, the programmable divider is faulty. For example:

Frequency measured at test point C or D : 140.506 MHz

Frequency measured at U14, pin 14: 22.85 KHz

Measured divider ratio: $\frac{140.506 \text{ KHz}}{22{,}85 \text{ KHz}} = 6149$

Correct frequency (CH 16, Rx): 139.900 MHz

Correct divider ratio: $\frac{139.900 \text{ KHz}}{25 \text{ KHz}} = 5596$

The divider ratios are different, thus the programmable divider is faulty.

4.3.4 --Continued.

In order to troubleshoot the programmable divider, first make sure that "programming" information is correct. Check the output of binary adders U5 and U6 (pin 10, 11, 12, 13) to verify that the modulus control counter is programmed correctly. As previously explained (3.4), the modulus control counter (U7/U8) is programmed by information from the microprocessor (A5) (synthesizer code, Table III, M90 Owner's Manual) to which is added a fixed number (offset):

MODE	OFFSET
Receive simplex	0
Receive duplex	4
Transmit	16

Thus an easy check is done on a simplex channel (for example, CH 16), by verifying that the synthesizer code is not altered by the binary adders (U5, U6) and applied, unchanged, to the modulus control counter input (U7, U8 pin 15, 1, 10, 9).

On receive duplex and transmit channels, binary add 4 and 16 respectively to the synthesizer code in order to get the modulus control counter input.

Ex.: CH 26

Bit:	7 6 5 4 3 2 1 0	
Synthesizer code:	0 1 1 0 0 0 0 0	
Receive duplex offset:	0 0 0 0 0 1 0 0	(Decimal 4)
Modulus control counter input:	0 1 1 0 | 0 1 0 0	
(MSBs), input to U8:	0 1 1 0	
(LSBs), input to U7:	0 1 0 0	

If the binary adders check out correct, verify that the correct "programming" information is present at the input to the programmable counter as shown below:

	U11				U12			
Pin #:	15	1	10	9	15	1	10	9
Receive simplex:	0	0	0	0	1	1	0	1
Receive duplex:	0	1	1	1	1	1	0	1
Transmit:	0	1	1	1	0	0	1	1

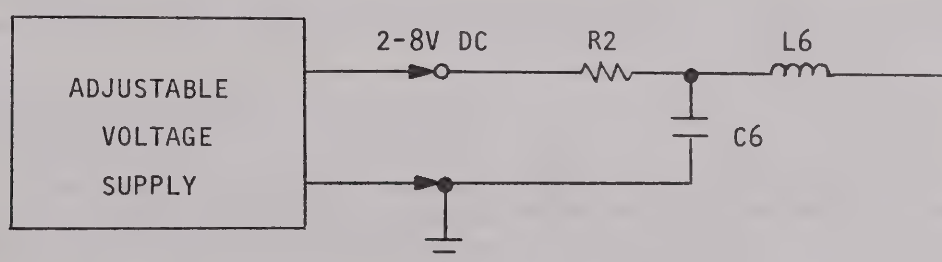
After checking the programming information, the modulus control counter (U7/U8) and the programmable counter (U11/U12) can be tested - to some degree - by observing the "Q"-outputs on an oscilloscope (U7, U8, U11, U12, pin 3, 2, 6, 7). The output signals should be square waves of varying duty cycles and approximately 4V p-p. Because these signals are derived from the signal at test point E , they will exhibit a similar "jitter". Missing signals or signals less than 2.5V p-p indicate problems.

If the modulus control counter and the programmable counter appear to be working, check the operation of the dual modulus prescaler (U3, U4) by measuring the frequency at test point E . The frequency should be approximately 30 times less than the frequency measured at test points C and D . Also observe the waveform.

VCO.

If the test performed on the programmable divider showed no problems in the divider, the problem causing wrong frequencies must be located in the VCO (Q2) or loop amplifier (U18) circuitry.

To find a problem in this part of the phase locked loop, it is necessary to "open" the loop by disconnected R2 at the junction of R1 and C44.



Select channel 16.

Apply a voltage to R2 as shown. While measuring the frequency on test point C or D , check that it is possible to obtain a frequency of 139.900 MHz with an applied voltage of approximately 3 volts.

Repeat the test on CH 591. If channel 591 is not accessible, use the highest receive frequency.

Check that it is possible to obtain a frequency of 146.650 MHz with an applied voltage of 7.5 volts or less.

If these frequency/voltage combinations are not possible, the problem is in the VCO circuitry. Check test point F to see if Q2 is O.K.

4.3.4 --Continued.

NOTE: Any change in the frequency determining components on the VCO will require a retuning of L4. Proceed as follows:

1. Loosen core on L4 with Q-dope thinner.

2. Select channel 591. If channel 591 is not accessible, use the highest receive frequency.

3. Measure voltage on test point G .

4. Adjust L4 for a voltage of 7.0V DC.

5. Check the highest Tx channel for a test point G voltage of less than 7.5V DC.

6. Q-dope core on L4.

If L4 has been changed, it is necessary to glue the new coil to the P.C. board with 5-minute epoxy.

DO NOT RETUNE L4 AND Q-DOPE - AS DESCRIBED ABOVE - BEFORE THE GLUE HAS COMPLETELY DRIED SINCE APPLYING THE GLUE WILL CAUSE A FREQUENCY CHANGE OF THE VCO.

ALSO MAKE SURE THAT THE GLUE DOES NOT TOUCH THE COIL WINDINGS.

PHASE DETECTOR/LOOP AMPLIFIER.

If the VCO circuitry checks out good, check the output (pin 13) of the phase detector (U14) with an oscilloscope while varying the voltage applied to R2 and measuring the frequency on test point C or D . Use CH 16 for this test.

With the frequency below 139.900 MHz (the correct frequency) the phase detector output will be "low" (approximately 0V).

As the frequency approaches 139.900 MHz a "beat note" should be observed at the phase detector output. Finally, moving the frequency above 139.900 MHz will cause the output to be "high" (approximately 5V).

Repeat this test while measuring the voltage as the output (pin 6) of the loop amplifier (U18). Because the loop amplifier is an inverting amplifier, the output will be high (approximately 8V) with the frequency measured at test point C or D below the correct frequency of 139.900 MHz and vice versa.

4.3.4 --Continued.

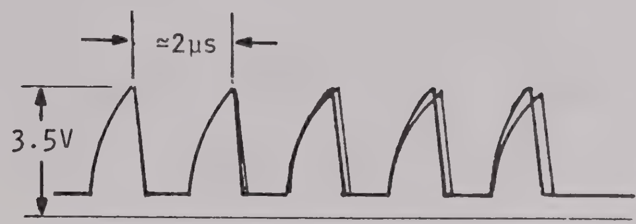
MICROPHONE AMPLIFIER.

When modulation problems are encountered, it is first necessary to verify that the problems are on the A1 board. This is most conveniently done by observing test point O with an oscilloscope while whistling into the microphone. If the correct signal is present, the problem is on the A1 board. Checking test points M, N, P, and Q should easily reveal the problem area.

If the microphone amplifier/limiter/filter checks out good, the problem is in the modulator circuitry (CR6, C76, L16).

FREQUENCY SYNTHESIZER, A1

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
A	B+	13.6V DC
B	Regulated 5V DC	4.8 - 5.2V DC
C	Rx Lo Output	$\geq$ +4dBm (350mV)
D	Tx Output	$\geq$ +4dBm (350mV)
E	÷30/31 Output	
F	Q2, Source	≈2.5V
G	VCO Control Voltage	CH 591: $\leq$7.5V DC CH 00 : ≈2.6V DC (Rx mode)
H	Rx/Tx Offset Control	Tx: 0V DC Rx: $\geq$3.5V DC
J	Simplex/Duplex Info	S: "0" D: "1"
K	Tx Inhibit	"0" when Tx is permitted "1" when Tx is inhibited
L	P.T.T.	Tx: "0" Rx: "1"
M	T+	13.6V DC
N	Regulated supply voltage to microphone amplifier	6.5 - 8.5V DC
O	Microphone input	.5 - 1.0V p-p when whistling

4.3.5 Display and Interface Circuitry Troubleshooting.

Display and interface circuitry problems can, in certain cases, be difficult to detect. This is due to the large number of connections within the display and interface circuitry itself (between the microprocessor/display (A5) and the interface (A4)) and between the display and interface circuitry and the rest of the transceiver.

Before attempting to troubleshoot the display and interface circuitry, it must be determined that the problem is actually within this circuitry. Proceed as follows:

- Check all supply voltages on the A4 as well as the A5 board. (Test point C on A5 and terminal B on A4 must be +5V; terminal A on A4 must be 13.6V.)

- Check that the synthesizer code corresponding to the selected channel is present on J1, pin 1, 16, 2, 15, 3, 14, 4, 13.

- Also check that S/D, T+, MIC, PTT is present on J1, pin 5, 12, 9 and 7 respectively by measuring the test points indicated.

If the supply voltages are not correct on the 13.6V and 5V terminal, A4, check (trace) the supply voltage wires to locate the problem.

If the voltages are correct on the A4 board, test point C on the A5 must be correct if the connections between the two boards are correct.

If the synthesizer code is not correct, the failure will appear as an A1 problem. Likewise, if S/D, T+, MIC or PTT is not correct.

After it has been determined that the problem is in the display and interface circuitry, proceed as follows:

- TONE:

  Check (on the A5 board) output from U1, pin 8, while pressing any number key. A square wave of approximately 5V p-p should be observed. If O.K., check test point B . If the square wave is not present, check test point A . If test point A checks out correct, U1 is most likely the problem. If no signal is observed on test point A , the problem could be U1 or the crystal Y1.

  If test point B does not check out correct, the problem is most likely U8.

4.3.5 --Continued.

- DIMMING:

  If a dimming problem exists with the channel indicator, the cause could be U1 or the display drivers U3, U4.

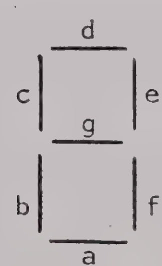
  Problems with the front panel LEDs or decimal point can be caused by U2, U7 or Q2-5.

- CHANNEL INDICATOR (DISPLAY)

  Problems with the channel indicator can result from faulty 7 segment displays (U5, U6), display drivers (U3, U4) or a faulty U1 on the A5 board.

  Checking the 7 segment display can be done easily be replacement.

  Checking the display driver is done by checking the input, 4 bit, code (pin 7, 1, 2, 6) and compare with the outputs (a, b, c, d, e, f, g) in accordance to the segment identification shown below:



  If both display and driver checks out correct, the problem is in U1.

- SYNTHESIZER CODE, STATUS CODE

  Incorrect synthesizer code and/or status information will - as mentioned earlier - appear as problems on the A1 board. The problem, however, is most likely the A5 board or the interconnection between the A4 and A5 board.

  To check the interconnection, switch cables.

  To check the A5 board, make sure that test point A (A5) checks out correct. Besides checking test points, the only other test that can be performed on the A5 board is replacing U1.

4.3.5 --Continued.

On the A4 board, U1 and U6 determine the status based upon the synthesizer code input. U1 can be checked by verifying that the correct synthesizer code is present at the input and that the particular synthesizer code results in the correct outputs (S/D, HI/LO PWR, etc.) on any channel. A partial check of U1 can be performed using the table below.

U1:

	INPUT CODE								OUTPUT CODE				CH #
pin #	19	18	17	5	4	3	2	1	14	13	8	7	
	0	1	1	0	1	1	1	0	1	1	0	0	1 (WX 1)
	1	0	0	0	1	1	0	0	0	1	1	0	16 US or INTL
	0	1	0	0	1	0	0	0	0	1	0	1	18 US or INTL

U6 can be checked using the table below.

	INPUT CODE					OUTPUT CODE				CH #
pin #	14	13	12	11	10	9	7	6	5	
	0	0	0	0	1	0	1	0	1	28 INTL
	0	0	1	0	1	0	0	1	1	16 INTL
	1	0	0	0	0	1	1	0	0	28 US
	1	0	1	0	0	1	0	1	0	16 US

- LOW POWER:

  If it is not possible to adjust the low power output with R15, the problem could be Q7 or CR6-9. It is important to note, however, that the tuning of the RF power amplifier (A2) affects the performance of the low power control circuitry. See 4.3.3 for proper tuning of the RF power amplifier (A2).

  If the power output remains low, regardless of the position of the HI/LO power switch (S2), a possible cause is U1 (pin 13 "stuck low"), Q4 or Q5. It is here assumed that the power amplifier (A2) checks out O.K.

- PTT, TX INHIBIT:

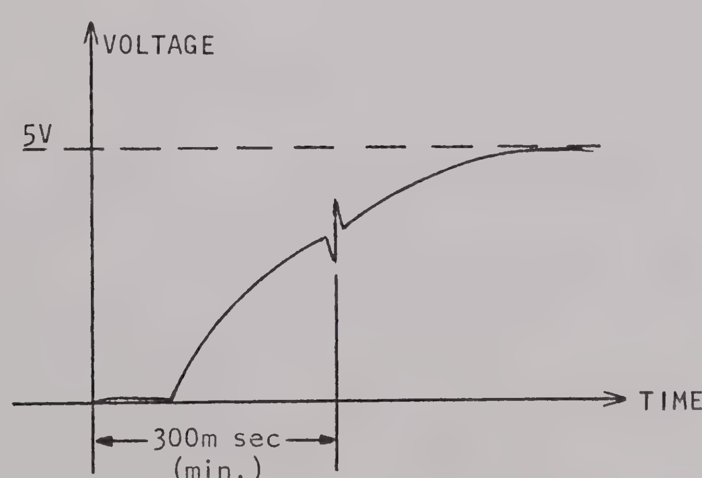
When the M-90/90R does not respond to keying commands, check U1, pin 14 (A4 board). A high level ("1") prevents PTT information from changing the output of U4 to turn on Q9 so that the T/R switch on A2 does not get activated. Also check U4, pin 9, 11, 2. A high ("1") level on any of these pins will also prevent keying.

If U5F, pin 15 is low, Q10 will be turned off which also prevents keying information from reading the T/R switch on A2.

- START-UP:

Start-up problems usually show up as wrong channel display or incorrect front panel light combinations. Turning off the unit and waiting a minute before turning it on again should clear up the problem.

The start-up delay circuit (Q11) is only necessary with the M90R and the M9 system. For proper operation, the collector of Q11 must exhibit the following response:



- INITIALIZATION:

Testing the initialization matrix is rather difficult since the matrix is used mainly following the turn on of the supply voltage. Problems are easily recognized though. Wrong scan speed and/or wrong squelch drop-out time is an initialization matrix problem. Likewise, if scan, search, priority or weather channel accessibility is different than programmed, the initialization matrix and associate circuitry is the problem. Before replacing U2, assure that U7D is operating correctly and that CR4, CR1 and any diode in the matrix is O.K.

DISPLAY AND INTERFACE CIRCUIT A4, A5

TEST POINT VALUES

A4

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
Terminal A	Supply voltage	13.6V DC nominal
Terminal B	5V regulated supply	4.8 - 5.2V DC
U6, pin 7	S/D info to A1	Simplex = low voltage level Duplex = high voltage level
Terminal AL	Transmit B+ voltage	Receive = low voltage level Transmit = 13.6V
Terminal H	Microphone input to A1	Speech audio or tone when talking or whistling into microphone
U5B, pin 4	PTT to A1	Microphone keyed: low level Microphone not keyed: high level

A5

TEST POINT		
A	Microprocessor clock oscillator	3.985513 MHz sine wave (nominal frequency)
B	Filtered key tone	150mV p-p sine wave, 800 Hz
C	5V regulated supply	4.8 - 5.2V DC

4.3.6 Private Channel Troubleshooting.

A problem associated with the private channel (A6) board is easily detected since the A6 board can conveniently be bypassed and possible faulty connections detected by switching interconnecting cables.

Since the private channel (A6) is basically a switch, troubleshooting consists of determining if "outputs" are identical to "inputs".

The switches are U1, U2 and U5.

Inputs are X_0 - X_3 for normal mode.

Inputs are Y_0 - Y_3 for P-channel mode.

Outputs are Z_0 - Z_3 for both modes.

Inputs in the P-channel mode is determined by the coding matrix. If the input/output information is correct, check that the coding is in accordance with the information in Table III, Owner's and Installation Manual, for the selected P-channel.

Test point A indicates if the normal mode or the P-channel mode is selected. Problems with the RF output power mode (hi or lo) are likely to be caused by U3, Q1-3. However, check that the wiring is correct in accordance to the P-channel installation instructions in the Owner's and Installation Manual.

NOTE: The private channel schematic (Figure 17) shows connections labeled for the M-80. Some connections were relabeled for the M90/90R, because the connections were used for different purposes.

Comparing Figure 17 with the interconnect diagram, Figure 21, it is seen that the following connections are different.

CONNECTOR, PIN	M80 LABEL	M90/90R LABEL
J2, 1	$\overline{\text{PRI IN}}$	NOT USED
J2, 14	$\overline{\text{ICB}}$	S/D (S=1)
J2, 10	$\overline{\text{EXT RES}}$	$\overline{\text{RESET}}$
J2, 7	+12V	INT LED
J3,9	$\overline{\text{RBO}}$	TONE
J3,5	+13.6V	VCC, 13.6V
J3,3	LO PWR LIGHT	FILTERED TONE
J3,4	US LIGHT	REMOTE LITE
J3,1	INT LIGHT	PWR IND LITE
J3,2	TX PWR LIGHT	USA LITE

PRIVATE CHANNEL, A6

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
A	P-channel control signal to micro-processor	P-channel "loaded": "0" P-channel "empty": "1"
B	Hi/lo power control	Hi power: "1" Lo power: "0"
C	Hi/lo power control	Hi power: "0" Lo power: "1"

4.3.7 Remote Control Interface Troubleshooting.

Troubleshooting of most of the remote control interface circuitry can be done in the M90R without the need for a M9 remote unit. To assure a working system, though, the M9 must be connected when checking.

- SUPPLY VOLTAGE:

  Lack of supply voltage when tuning on the M90/90R indicates a problem with the relay, K1.

- REMOTE LIGHT, HI/LO PWR:

  If the remote light is on, even after activating the E key, the problem could be on the A7 board (otherwise check A5 board). Check terminal P (or AD).

  Hi/lo power problems usually show up as a failure to obtain high power. Again, U1 is the problem. If local control is obtained (U1B, pin 3 low level) and U1D, pin 11 is low, U1C, pin 10 and therefore terminal X1 must be high in order to control the hi/lo power switching on the A4 board.

- DATA BUS:

  A problem in the data bus can be detected by monitoring terminal 10 and M with an oscilloscope and pressing the E key to transmit data. (For continuous transmission of data, load <u>one</u> channel into scan and start scan.)

  Signals at terminals 10 and M must be identical.

  Problems in U3 can be detected by removing the connection (blue) between A4 and A7 and ground it to the chassis. The signal on terminal K must now be identical to the signal on terminals 10 and M.

- TX, RX AUDIO AND INTERCOM:

  To troubleshoot the operation of the Tx audio/intercom driver, U2A U4, set up equipment for transmitter check in lo power per 4.2.2. Key the transmitter and talk or whistle into microphone. Monitor terminal 1 and terminal J alternately with an oscilloscope and check that the audio levels are identical. While keying the microphone on and off, check that the DC output level on terminal 1 alternates between approximately 1.4V and 6V.

  If no DC voltage change is observed, check U2A, pin 13. If correct output is observed on U2A, U4 is faulty.

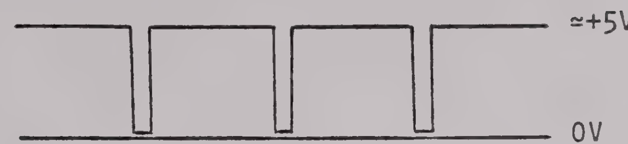
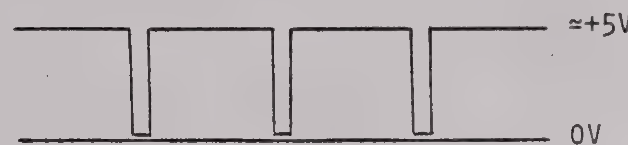
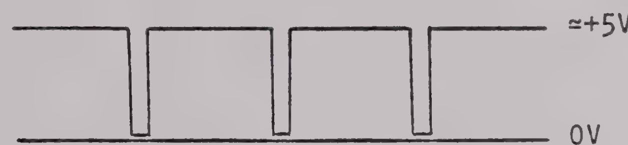
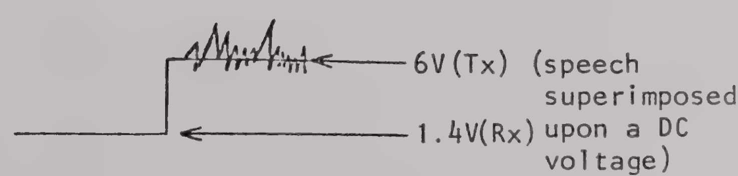
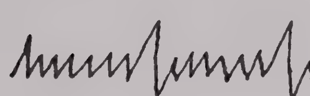
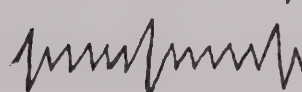
4.3.7 --Continued.

Monitoring terminal 7 while talking or whistling into microphone will show if U5 - the Rx audio intercom driver - is operating correctly. A gain of approximately 5 times should be observed between terminals 7 and J.

Problems with squelch can be traced by monitoring the DC voltage on terminal AU while keying the microphone on and off. The DC level should be low in the Tx mode and high in the Rx mode. Performing the same test while monitoring U2B, pin 1 checks the local muting circuitry. If U2B works, the problem is Q5.

REMOTE CONTROL INTERFACE, A7

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
Terminal P	Remote light	Local: low level Remote: high level
Terminal X1	Hi/lo power control	Local: high level Remote: low level
Terminal 10	Data bus	
Terminal M	Data out from microprocessor	
Terminal K	Data input to microprocessor	
Terminal 1	Tx audio output	
Terminal J	Microphone input	 (speech)
Terminal 7	Rx audio output	 (speech)
Terminal AU	Squelch inhibit	With microphone keyed: low voltage (≈0V) Normal mode (Rx): 0.7V

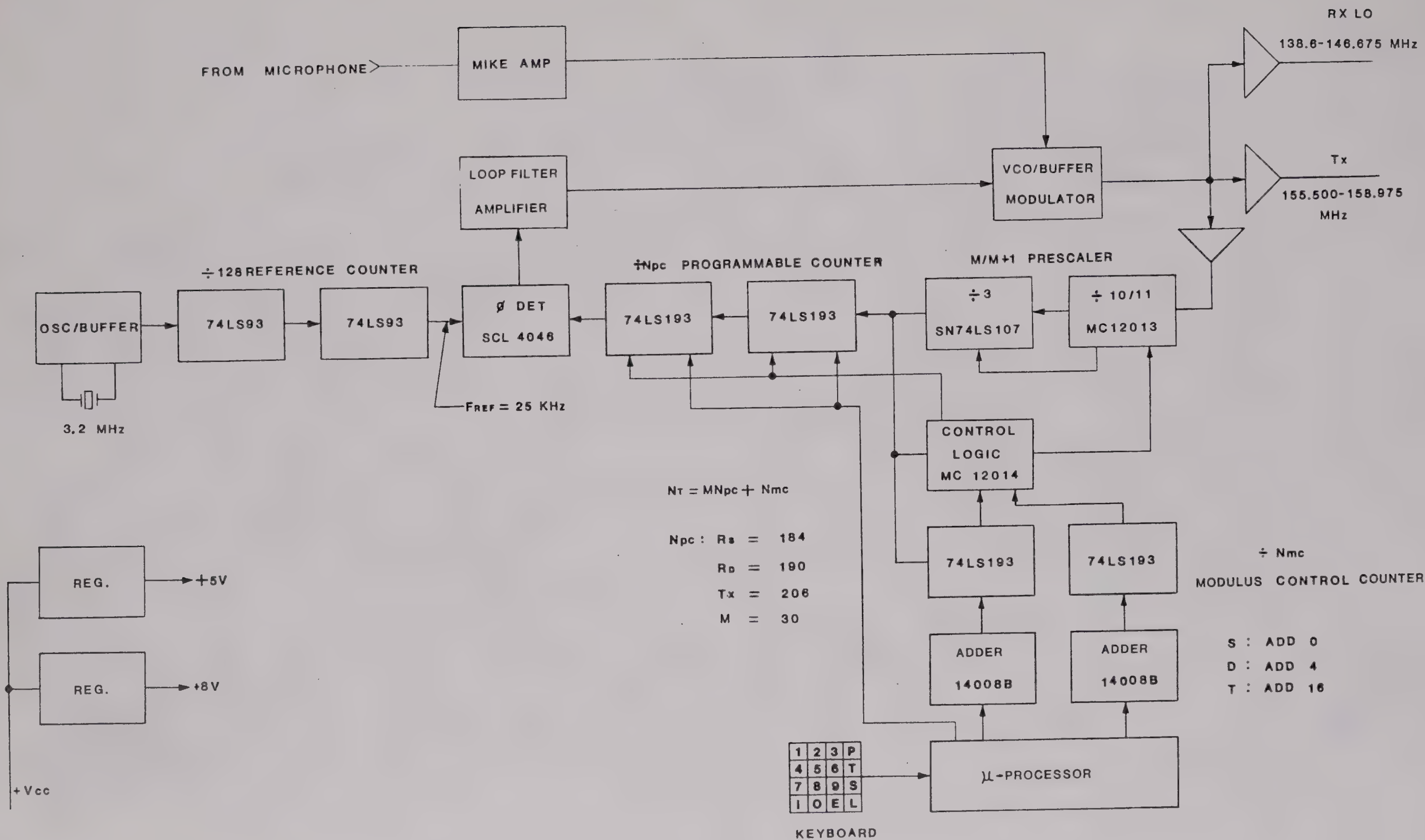


FIGURE 6
SYNTHESIZER BLOCK DIAGRAM

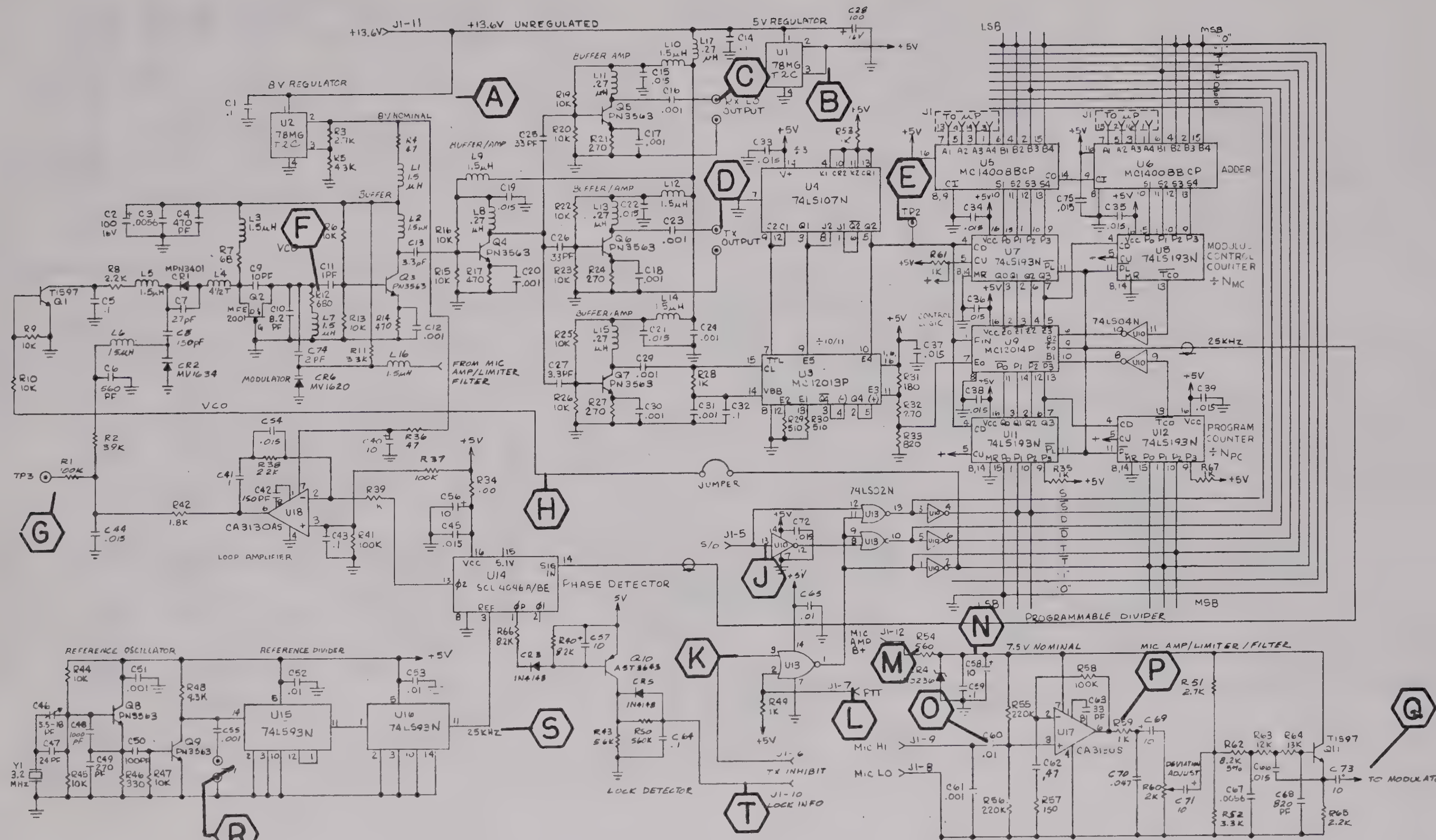


FIGURE 7

A1 SYNTHESIZER SCHEMATIC

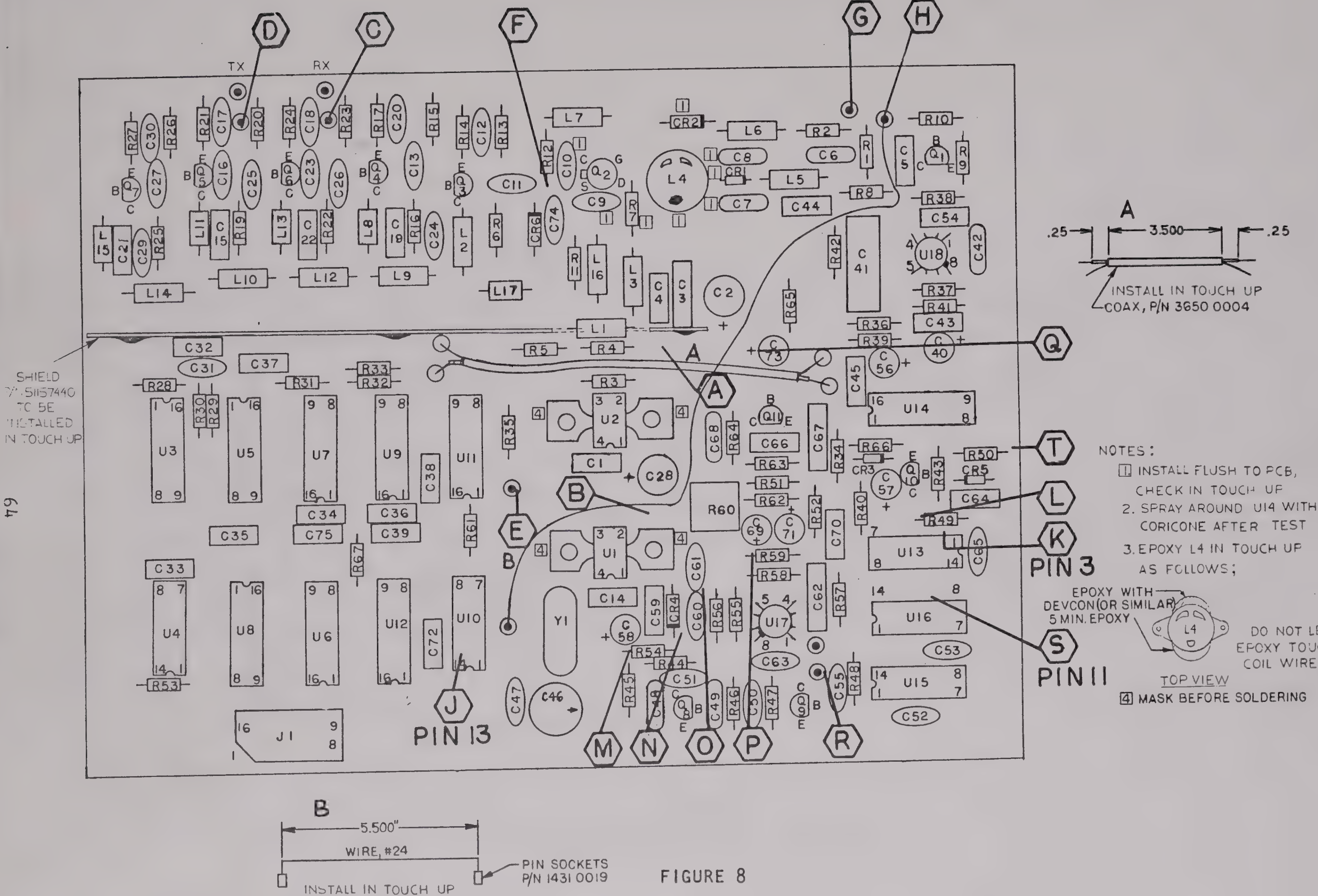
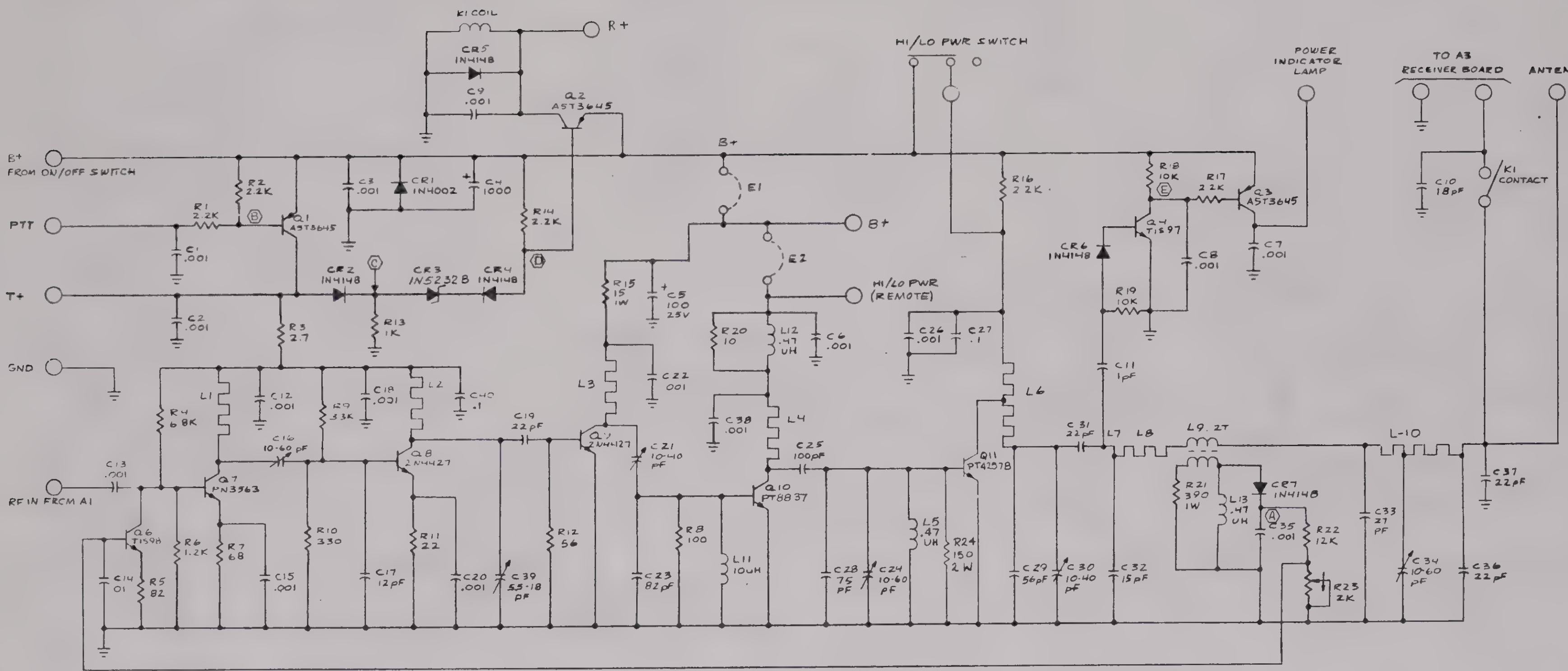


FIGURE 8

A1 SYNTHESIZER COMPONENT LOCATIONS



NOTES: U.S.O.
1. L1 IS 2T #26 BIFILART ON T30-0 CORE.
2. ⎍⎍⎍ DENOTES PRINTED CIRCUIT COIL.

FIGURE 9

A2 RF POWER AMPLIFIER SCHEMATIC

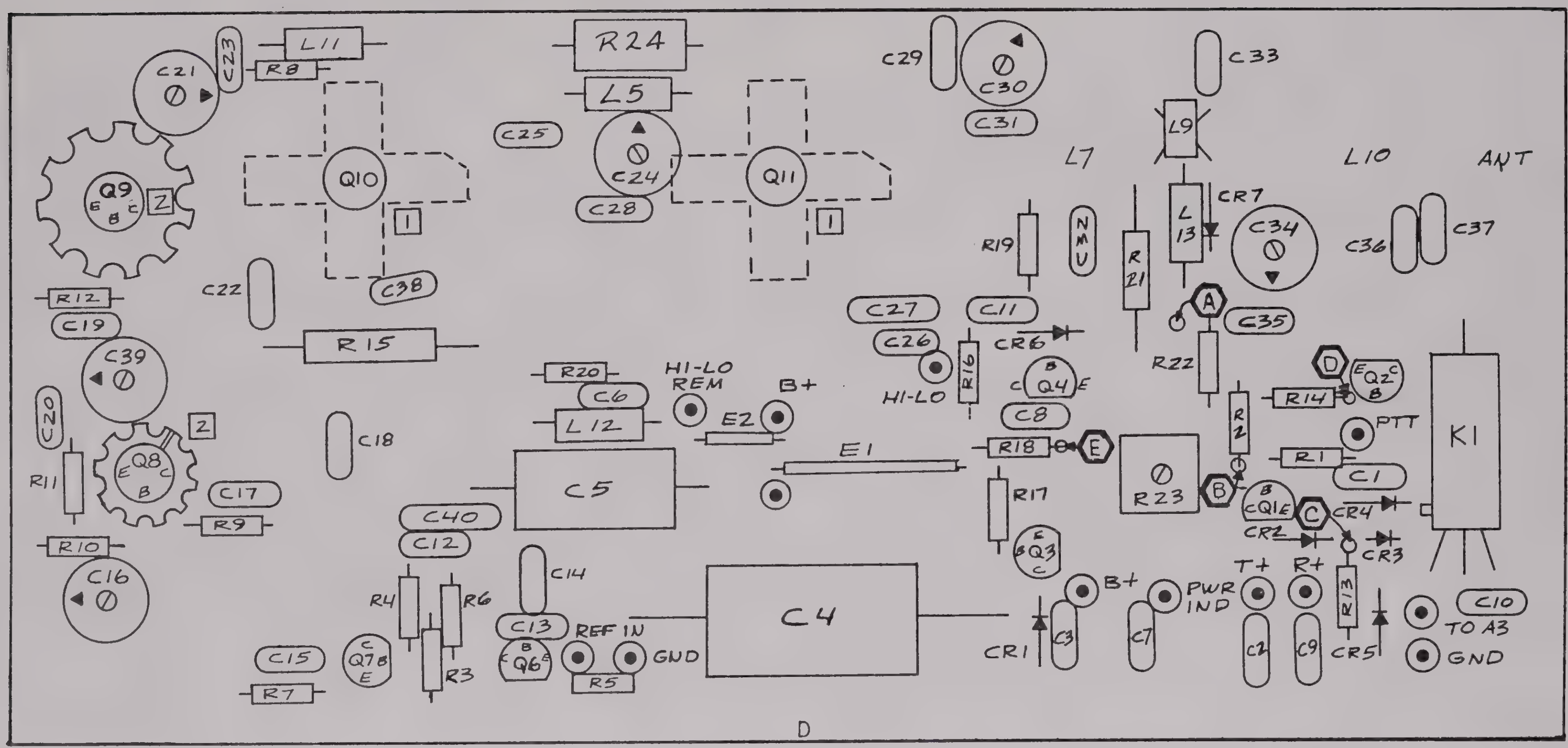
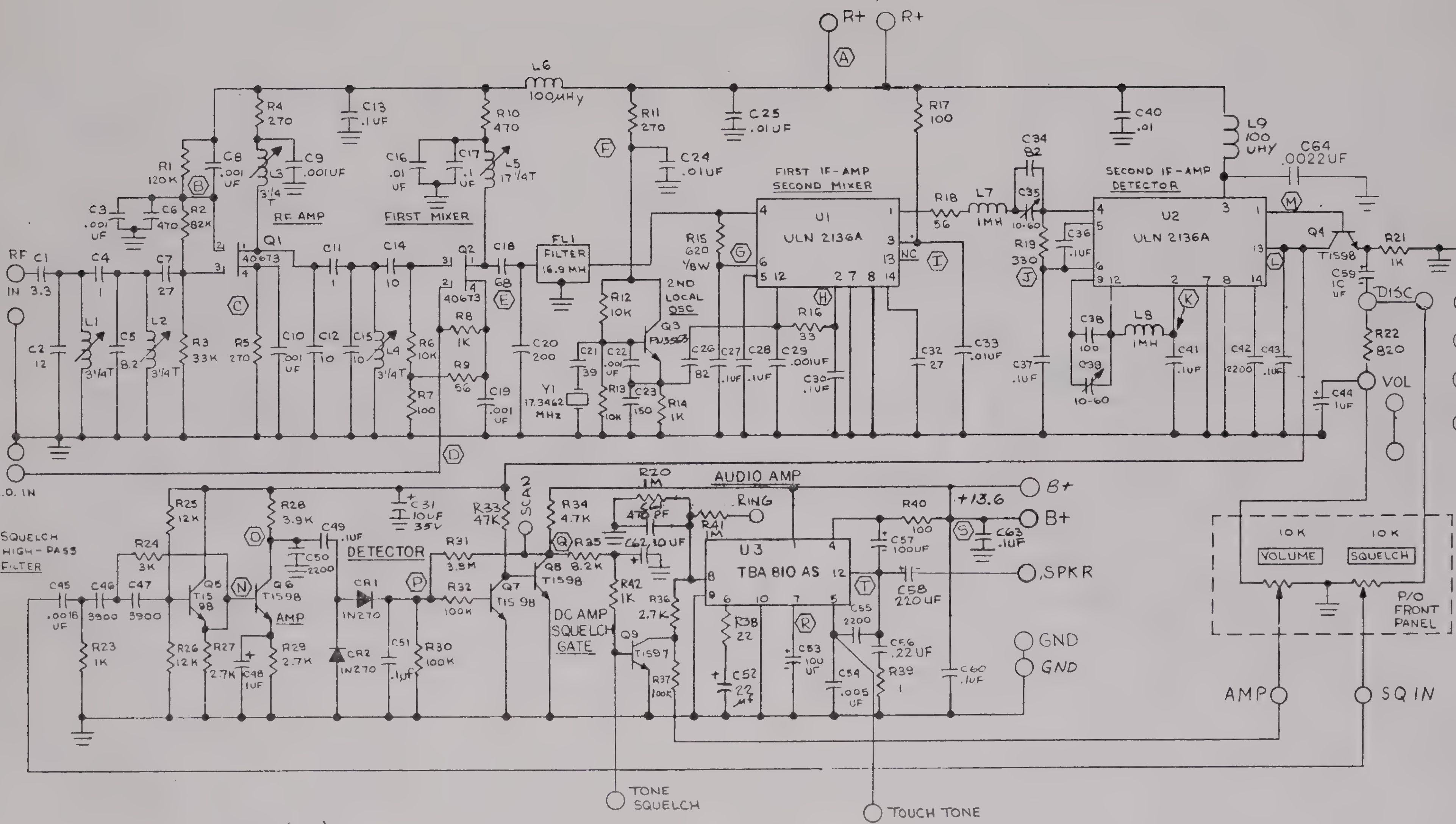


FIGURE 10

A2 RF POWER AMPLIFIER COMPONENT LOCATIONS



NOTES: (UOS)

1. ALL RES. ARE 1/4W, 10% AND VALUES IN OHMS.
2. ALL CAP. ARE IN PF.
3. ALL INDUCTOR VALUES ARE IN JH.

Ⓧ INDICATES TEST POINTS.

FIGURE 11

A3 RECEIVER SCHEMATIC

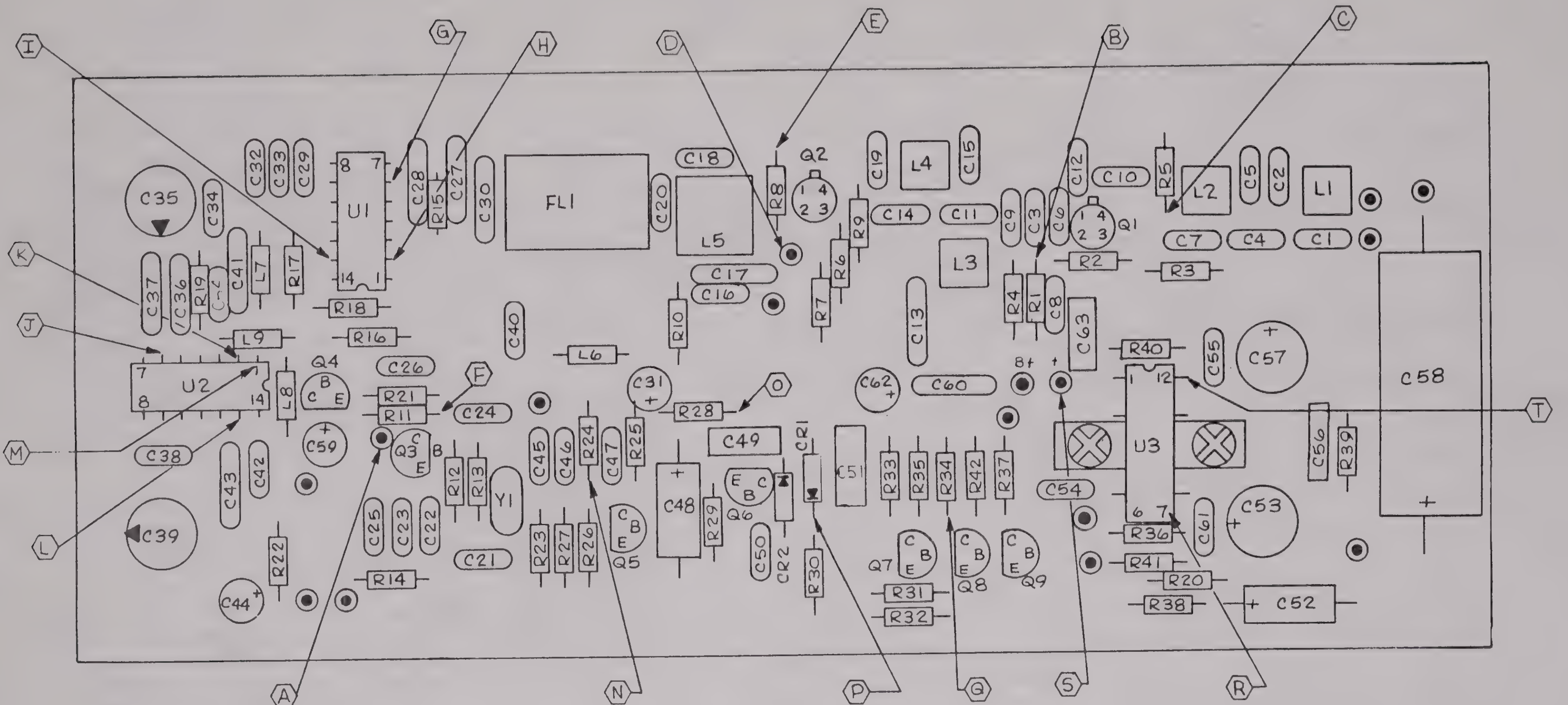


FIGURE 12

A3 RECEIVER COMPONENT LOCATIONS

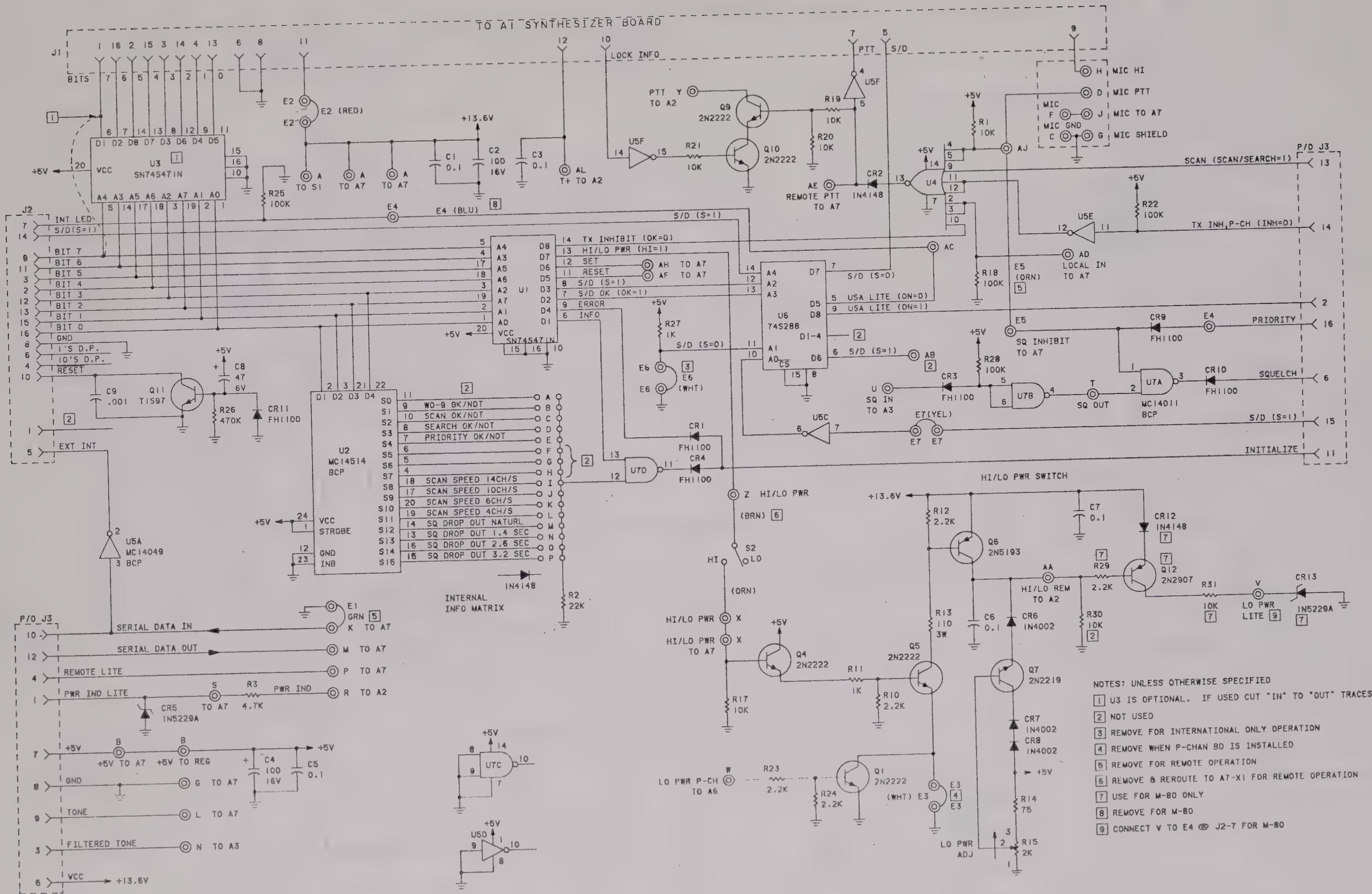


Figure 13 A4 Interface Schematic

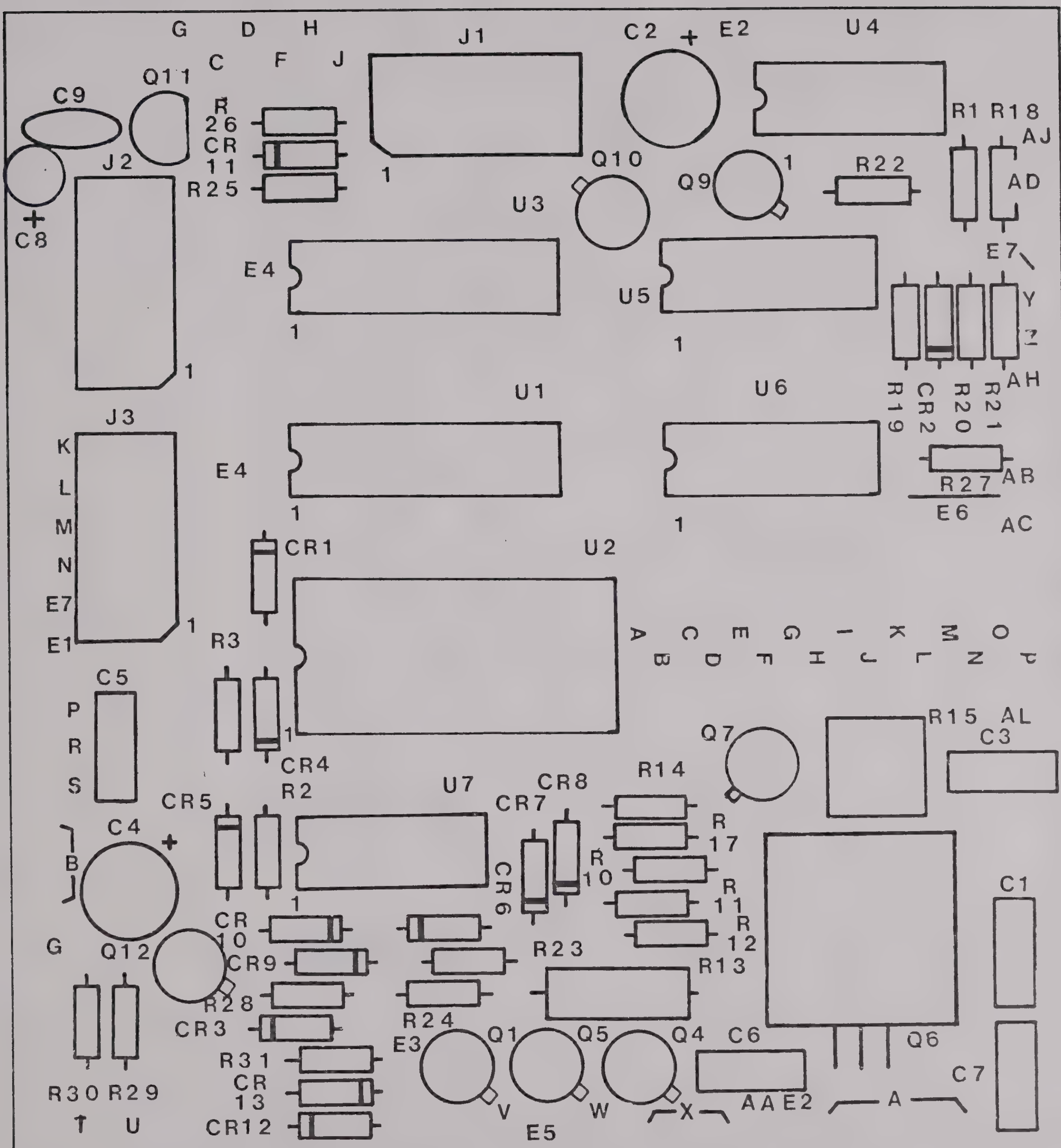


FIGURE 14

A4 INTERFACE COMPONENT LOCATIONS

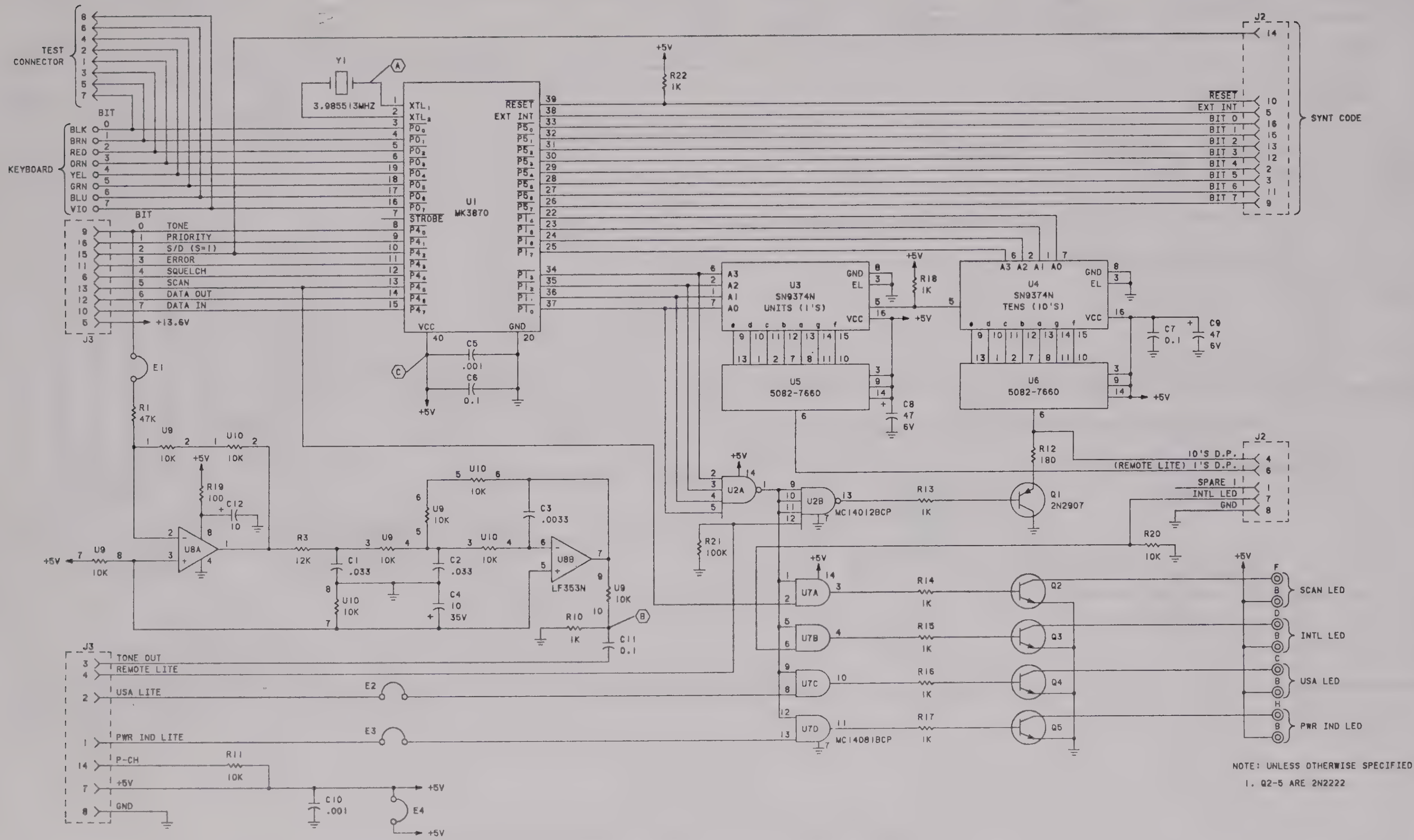


Figure 15 A5 Microprocessor/Display Schematic

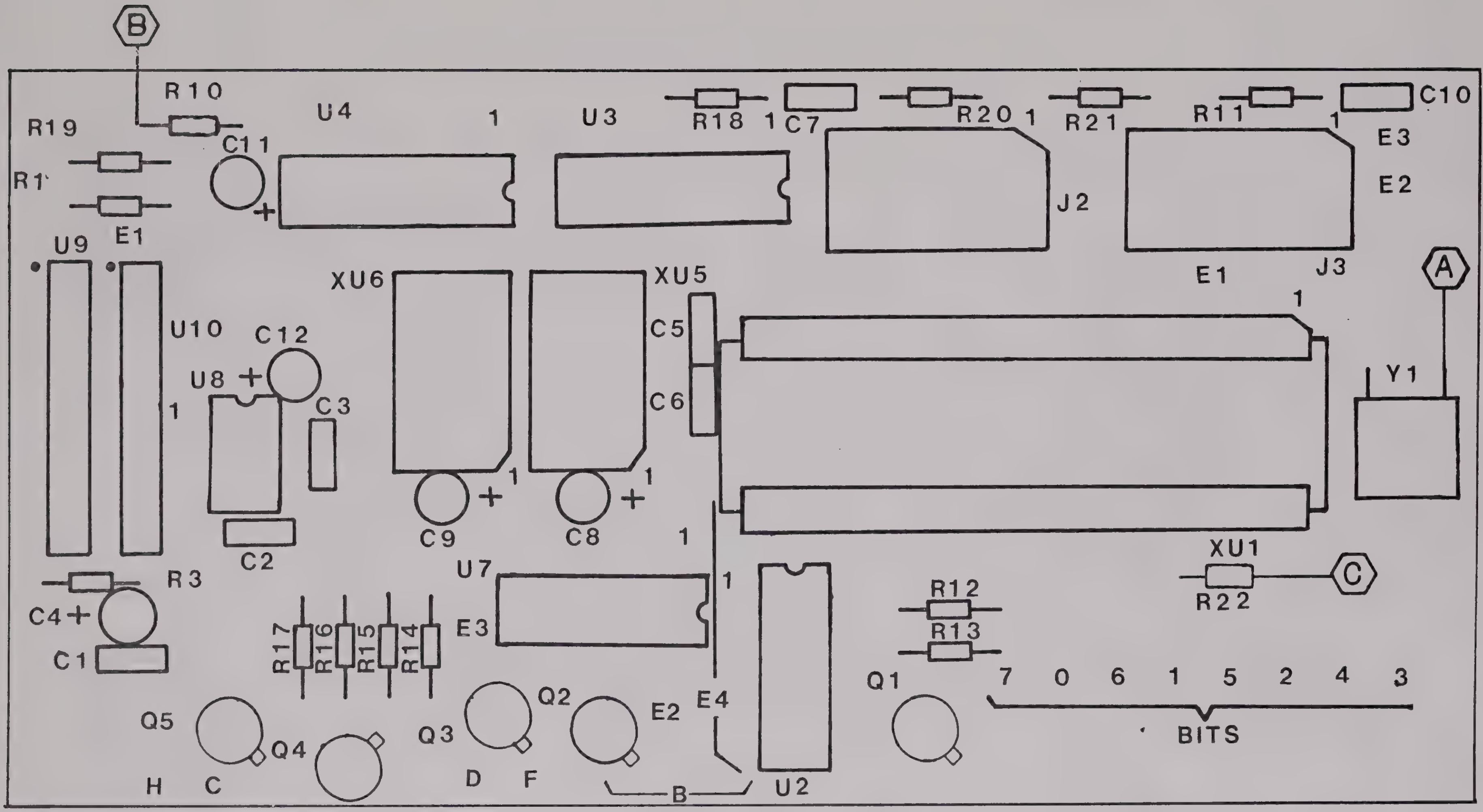


FIGURE 16

A5 MICROPROCESSOR/DISPLAY COMPONENT LOCATIONS

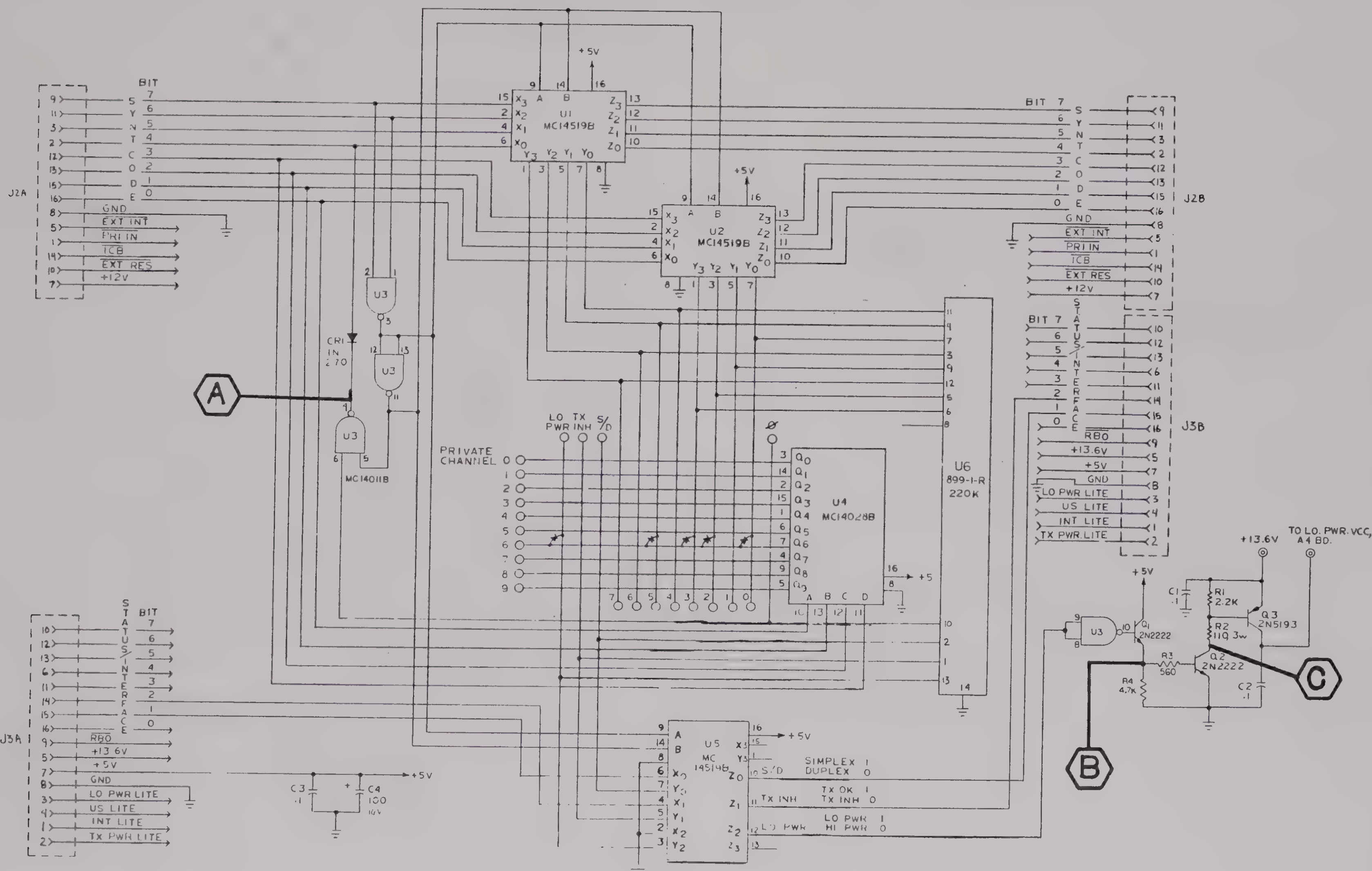


FIGURE 17

A6 PRIVATE CHANNELS SCHEMATIC

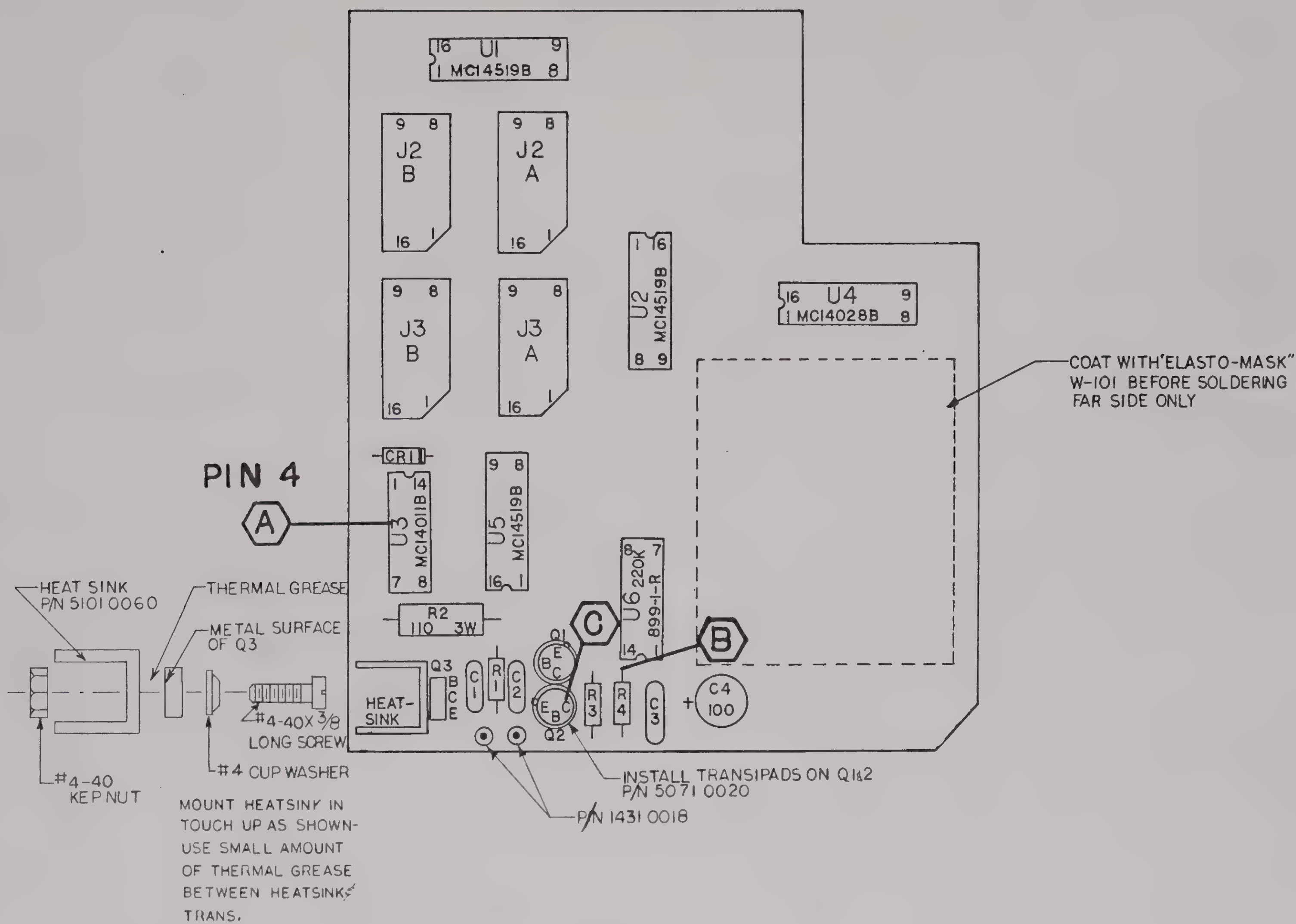


FIGURE 18

A6 PRIVATE CHANNELS COMPONENT LOCATIONS

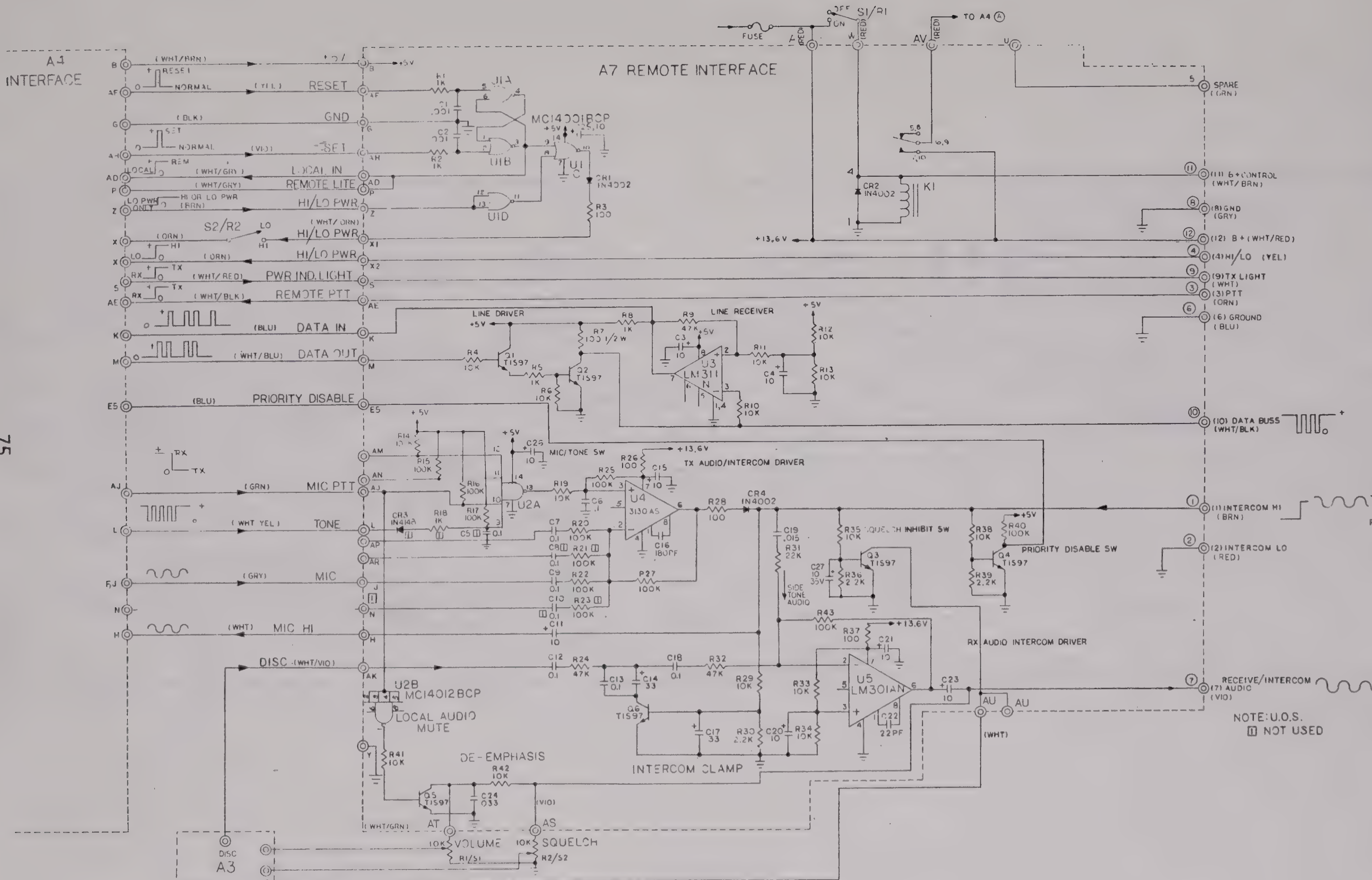


FIGURE 19

A7 REMOTE INTERFACE SCHEMATIC

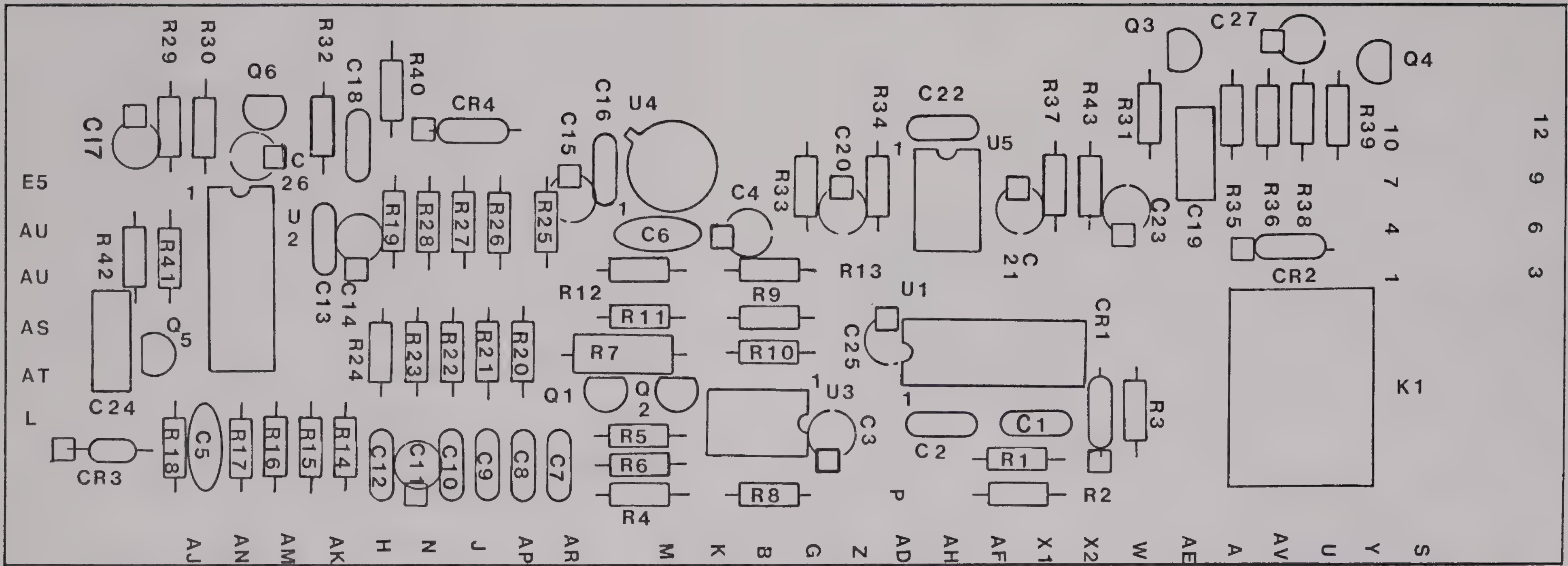


FIGURE 20

A7 REMOTE INTERFACE COMPONENT LOCATIONS

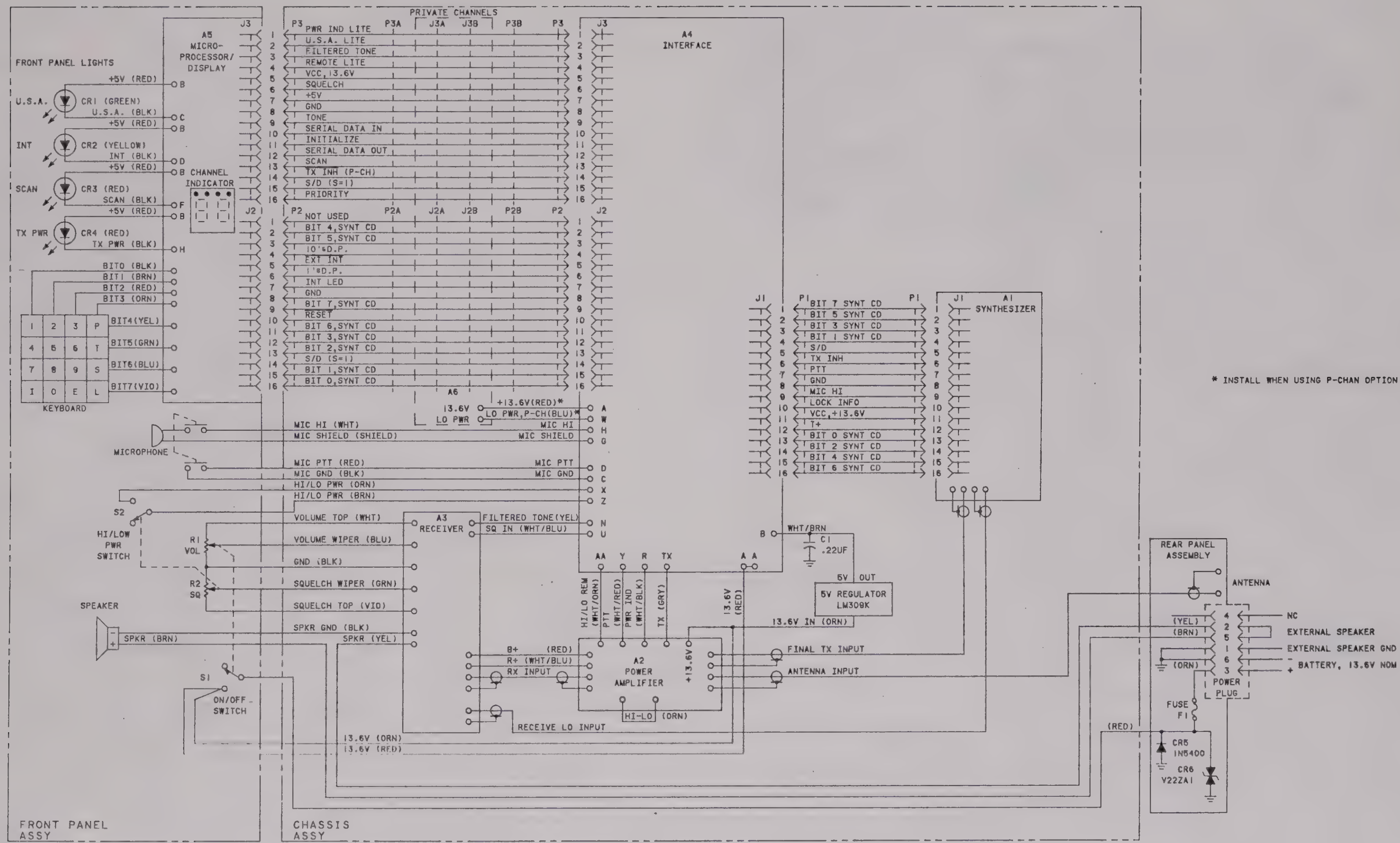


Figure 21a Mariner 90 Interconnect Diagram

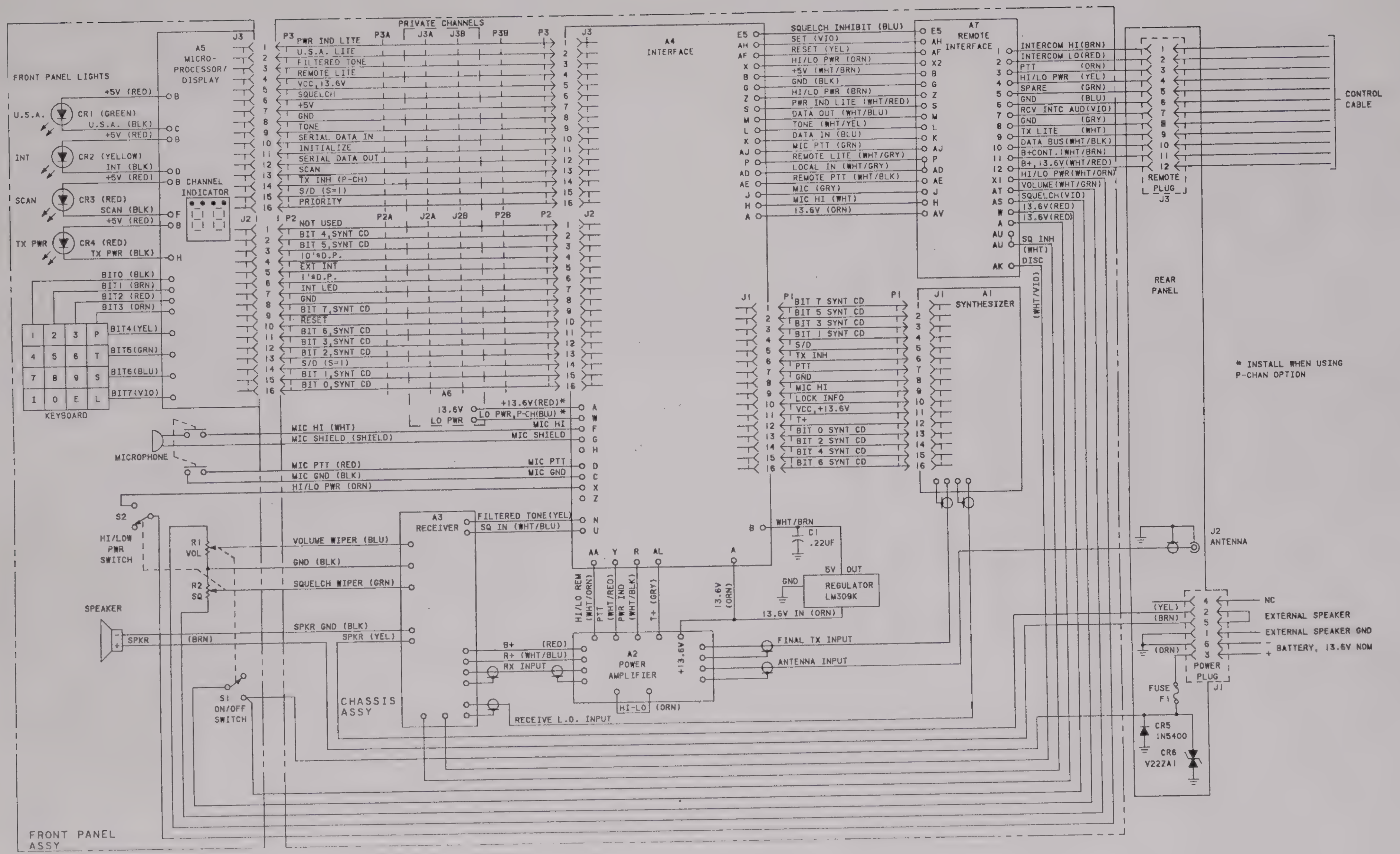


Figure 21b Mariner 90R Interconnect Diagram

5.2 Synthesizer, A1 (9115 7173)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0001	1	CAP., 1PF	C11	
1008 0005	1	CAP., 2PF	C74	
1008 0008	2	CAP., 3.3PF	C13,27	
1008 0014	1	CAP., 8.2PF	C10	
1008 0015	1	CAP., 10PF	C9	
1008 0024	3	CAP., 33PF	C25,26,63	
1008 0032	1	CAP., 100PF	C50	
1008 0042	1	CAP., 470PF	C4	
1008 0047	13	CAP., .001μF	C12,16-18,20,23,24,29-31,51,55,61	
1008 0055	4	CAP., .01μF	C52,53,60,65	
1008 0082	1	CAP., 24PF	C47	
1012 1016	2	CAP., 100μF, 16V	C2,28	
1024 0114	1	CAP., 27PF	C7	
1024 0133	2	CAP., 150PF	C8,42	
1024 0140	1	CAP., 270PF	C49	
1024 0149	1	CAP., 560PF	C6	
1024 0153	1	CAP., 820PF	C68	
1024 0155	1	CAP., 1000PF	C48	
1028 0255	1	CAP., 1μF	C41	
1028 0262	17	CAP., .015μF	C15,19,21,22,33-39,44,45,54,66,72,75	
1028 0264	1	CAP., .047μF	C70	
1028 0266	7	CAP., .1μF	C1,5,14,32,43,59,64	
1028 0268	1	CAP., .47μF	C62	
1028 0271	2	CAP, .0056μF	C3,67	
1044 0300	7	CAP., 10μF, 35V	C40,56-58,69,71,73	
1104 0011	1	CAP., VARIABLE, 5.5-18PF	C46	
1200 0050	1	COIL, Fixed, 4½ TURNS	L4	
1200 0505	5	COIL, Fixed, .27μHY	L8,11,13,15,17	

LIST OF COMPONENTS

5.2 Synthesizer, A1 (9115 7173)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1200 0659	1	COIL, Fixed, 1.5μHY		
1440 0055	1	I.C. SOCKET, 16 pin		
1600 0402	1	CRYSTAL, 3.2 MHz	Y1	
2702 0108	1	POT., 2K	R60	
2810 0107	1	DIODE, 1N5236, Zener	CR4	
2810 0110	1	DIODE, MPN3401	CR1	
2810 0111	1	DIODE, MV1620	CR6	
2810 0207	1	DIODE, MV1634	CR2	
2810 0269	2	DIODE, 1N4148	CR3,5	
2810 0122	1	FET, MFE2001	Q2	
2850 0238	1	I.C., CA3130AS	U18	
2850 0239	1	I.C., CA3130S	U14	
2850 0240	2	I.C., 78MGT2C	U1,2	
2860 0160	4	I.C., 74LS193N	U7,8,11,12	
2860 0161	1	I.C., 74LS107N	U4	
2860 0162	2	I.C., 74LS93N	U15,16	
2860 0163	1	I.C., 74LS04N	U10	
2860 0164	1	I.C., 74LS02N	U13	
2860 0166	1	I.C., MC12013P	U3	
2860 0167	1	I.C., MC12014P	U9	
2860 0168	2	I.C., MC14008BCP	U5,6	
2860 0315	1	I.C., SCL4046A/BE	U14	
2870 0104	2	TRANSISTORS, TIS97	Q1,11	
2870 0121	1	TRANSISTORS, A5T3645	Q10	
2870 0188	7	TRANSISTORS, PN3563	Q3-9	

5.3 Power Amplifier, A2 (9115 6803)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0001	1	CAP., 1PF	C11	
1008 0016	1	CAP., 12PF	C17	
1008 0017	1	CAP., 15PF	C32	
1008 0018	1	CAP., 18PF	C10	
1008 0020	4	CAP., 22PF	C19,31,36,37	
1008 0022	1	CAP., 27PF	C33	
1008 0028	1	CAP., 56PF	C29	
1008 0030	1	CAP., 75PF	C28	
1008 0031	1	CAP., 82PF	C23	
1008 0032	1	CAP., 100PF	C25	
1008 0047	16	CAP., .001µF	C1-3,6-9,12,13,15,18, 20,22,26,35,38	
1008 0055	1	CAP., .01µF	C14	
1008 0061	2	CAP., .1µF	C27,40	
1012 0008	1	CAP., 100µF, 25V	C5	
1012 0012	1	CAP., 1000µF	C4	
1104 0005	2	CAP., VARIABLE 10-40PF	C21,30	
1104 0006	3	CAP., VARIABLE 10-60PF	C16,24,34	
1104 0011	1	CAP., VARIABLE 5.5-18PF	C39	
1200 0025	1	COIL, 2T #26 BIFILAR	L9	
1200 0653	3	COIL, FIXED, .47µHY	L5,12,13	
1200 0669	1	COIL, FIXED, 10µHY	L11	
2702 0108	1	RES., VARIABLE, 2K	R23	
2810 0232	1	DIODE, 1N4002	CR1	
2810 0269	5	DIODE, 1N4148	CR2,4-7	
2810 0436	1	DIODE, 1N5232B	CR3	
2870 0104	1	TRANSISTOR, TIS97	Q4	
2870 0105	1	TRANSISTOR, TIS98	Q6	
2870 0121	3	TRANSISTOR, A5T3645	Q1-3	
2870 0188	1	TRANSISTOR, PN3563	Q7	

LIST OF COMPONENTS

5.3 Power Amplifier, A2 (9115 6803)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
2870 0205	2	TRANSISTOR, 2N4427	Q8,9	
2870 0216	1	TRANSISTOR, PT4257B	Q11	
2870 0251	1	TRANSISTOR, PT8837	Q10	
3001 0015	1	RELAY	K1	
3650 0008	1	COAX, WHT, 196A/U		
5071 0017	1	HEATSINK TRANSISTOR	Q9	
5071 0018	1	HEATSINK TRANSISTOR	Q8	
5071 0024	2	TRANSISTOR PADS	Q8.9	

LIST OF COMPONENTS

5.4 Receiver, A3 (9115 6771)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0001	2	CAP., 1PF	C4,11	
1008 0008	1	CAP., 3.3PF	C1	
1008 0014	1	CAP., 8.2PF	C5	
1008 0015	3	CAP., 10PF	C12,14,15	
1008 0016	1	CAP., 12PF	C2	
1008 0022	2	CAP., 27PF	C7,32	
1008 0025	1	CAP., 39PF	C21	
1008 0029	1	CAP., 68PF	C18	
1008 0031	2	CAP., 82PF	C26,34	
1008 0034	1	CAP., 150PF	C23	
1008 0036	1	CAP., 200PF	C20	
1008 0042	2	CAP., 470PF	C6,61	
1008 0047	7	CAP., .001µF	C3,8-10,19,22,29	
1008 0049	1	CAP., .0018µF	C47	
1008 0050	4	CAP., 2200PF	C42,50,55,64	
1008 0055	5	CAP., .01µF	C16,24,25,33,40	
1008 0061	10	CAP., .1µF	C13,17,27,28,30,36,37, 41,43,60	
1008 0065	1	CAP., .005µF	C54	
1008 0072	2	CAP., 3900PF	C46,47	
1012 0001	1	CAP., 1µF, 50V	C48	
1012 0005	1	CAP., 22µF, 16V	C52	
1012 0009	1	CAP., 220µF	C58	
1012 1016	2	CAP., 100µF, 16V	C53,57	
1024 0129	1	CAP., 100µF	C38	
1028 0251	1	CAP., .22µF	C56	
1028 0266	3	CAP., .1µF	C49,51,63	
1044 0300	3	CAP., 10µF, 35V	C31,59,62	
1044 0303	1	CAP., 1µF	C44	
1104 0006	2	CAP., VARIABLE, 10-60PF	C35,39	

5.4 Receiver, A3 (9115 6771)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1200 0536	2	COIL, FIXED, 100µHY	L6,9	
1200 0548	2	COIL, FIXED, 1mHY	L7,8	
1250 0033	1	COIL, VARIABLE, 7¼T	L5	
1250 0061	4	COIL, VARIABLE, 3¼T	L1-4	
1600 0206	1	CRYSTAL, 17.3462 MHz	Y1	
1800 0003	1	FILTER, 16.9 MHz	FL1	
2810 0117	2	DIODE, 1N270	CR1,2	
2820 0103	2	FET, SINGLE, 40673	Q1,2	
2850 0150	2	I.C., ULN2136A	U1,2	
2850 0178	1	I.C., TBA810AS	U3	
2870 0104	1	TRANSISTOR, TIS97	Q9	
2870 0105	5	TRANSISTOR, TIS98	Q4-8	
2870 0188	1	TRANSISTOR, PN3563	Q3	

5.5 Interface, A4 (9115 7696)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0047	1	CAP., .001µF	C9	
1012 1016	2	CAP., 100µF, 16V	C2,4	
1028 0266	5	CAP., .1µF	C1,3,5-7	
1044 0302	1	CAP., 47µF, 6V	C8	
1440 0055	3	CONNECTOR, 16 PIN	J1-3	
1440 0068	2	DIP SOCKET, 20 PIN	U1,3	
2546 3111	1	RES., 110Ω, 3W	R13	
2702 0108	1	POT., 2K	R15	
2810 0104	6	DIODE, FH1100	CR1,3,4,9-11	
2810 0209	2	DIODE, 1N5229A	CR5,13	
2810 0232	3	DIODE, 1N4002	CR6-8	
2810 0270	2	DIODE, 1N4148	CR2,12	
2860 0171	1	I.C., MC14049BCP	U5	
2860 0175	1	I.C., MC14011BCP	U7	
2860 0233	1	I.C., SN74S471N	U1	U.S. Standard Program
2860 0351	1	I.C., MC14514BCP	U2	
2860 0352	1	I.C., MC14078BCP	U4	
2870 0100	5	TRANSISTOR, 2N2222	Q1,4,5,9,10	
2870 0104	1	TRANSISTOR, TIS97	Q11	
2870 0111	1	TRANSISTOR, 2N2907	Q12	
2870 0128	1	TRANSISTOR, 2N5193	Q6	
2870 0139	1	TRANSISTOR, 2N2219	Q7	
5071 0033	1	HEATSINK	MPQ6	

5.6 Microprocessor/Display, A5 (9115 7710)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1006 1032	2	CAP., .001µF	C5,10	
1006 1037	1	CAP., .0033µF	C3	
1006 1043	2	CAP., .033µF	C1,2	
1006 1046	3	CAP., .1µF	C6,7,11	
1044 0300	2	CAP., 10µF, 35V	C4,12	
1044 0302	2	CAP., 47µF, 6V	C8,9	
1400 0011	2	CONNECTOR, 14 PIN	XU5,6	
1440 0055	2	CONNECTOR, 16 PIN	J2-3	
1440 0069	1	DIP SOCKET, 40 PIN	U1	
1600 1027	1	CRYSTAL, 3.985513 MHz	Y1	HC-32/U
1900 0028	2	L.E.D. DIGIT, YELLOW	U5,6	5082-7660 HP
2850 0259	1	I.C., LF353N	U8	
2860 0165	2	I.C., SN9374N	U3,4	
2860 0174	1	I.C., MC14081BCP	U7	
2860 0359	1	I.C., MC14012BCP	U2	
2860 0362	1	I.C., MK3870	U1	
2870 0100	4	TRANSISTOR, 2N2222	Q2-5	
2870 0111	1	TRANSISTOR, 2N2907	Q1	

5.7 Private Channels, A6 (9115 7276)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1006 1362	3	CAP., .1μF	C1-3	
1012 1022	1	CAP., 100μF	C4	
2546 3111	1	RES., 110Ω, 3W	R2	
2550 0066	1	I.C., 899-1-R, 220K	U6	
2810 0117	1	DIODE, 1N270	CR1	
2860 0175	1	I.C., MC14011B	U3	
2860 0176	1	I.C., MC14028B	U4	
2860 0177	3	I.C., MC14519B	U1,2,5	
2870 0100	2	TRANSISTOR, 2N2222	Q1,2	
2870 0128	1	TRANSISTOR, 2N5193	Q3	
5101 0060	1	HEATSINK	Q3	

5.8 Remote Control Interface, A[illegible]

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0020	1	CAP., [illegible]	C22	
1008 0035	1	CAP., [illegible]	C16	
1008 0047	2	CAP., .00[illegible]	C1,2	
1008 0081	6	CAP., [illegible]	C6,7,9,12,13,18	
1028 0262	1	CAP., .[illegible]	C19	
1028 0263	1	CAP., .[illegible]	C24	
1044 0307	2	CAP., [illegible] 25[illegible]	C14,17	
1044 0318	10	CAP., [illegible] 35[illegible]	C3,4,11,15,20,21,23, 25-27	
1440 0056	1	SOCKET, [illegible]	XK1	
1440 0058	1	RELAY RE[illegible] CL[illegible]	XK1	
2810 0232	3	DIODE, 1N[illegible]	CR1,2,4	
2850 0156	1	I.C., LM[illegible]	U3	
2850 0210	1	I.C., LM3[illegible]	U5	
2850 0239	1	I.C., 31[illegible]	U4	
2860 0173	1	I.C., MC[illegible]CP	U1	
2860 0359	1	I.C., MC14[illegible]CP	U2	
2870 0104	6	TRANSISTOR, [illegible]	Q1-6	
3001 0043	1	RELAY DP[illegible]	K1	

5.8 Remote Control Interface, A7 (9115 7727)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0020	1	CAP., 22PF	C22	
1008 0035	1	CAP., 180PF	C16	
1008 0047	2	CAP., .001μF	C1,2	
1008 0081	6	CAP., .1μF	C6,7,9,12,13,18	
1028 0262	1	CAP., .015μF	C19	
1028 0263	1	CAP., .033μF	C24	
1044 0307	2	CAP., 33μF, 25V	C14,17	
1044 0318	10	CAP., 10μF, 35V	C3,4,11,15,20,21,23, 25-27	
1440 0056	1	SOCKET, RELAY DPDT	XK1	
1440 0058	1	RELAY RETAINER CLIP	XK1	
2810 0232	3	DIODE, 1N4002	CR1,2,4	
2850 0156	1	I.C., LM311H	U3	
2850 0210	1	I.C., LM301AN	U5	
2850 0239	1	I.C., 3130AS	U4	
2860 0173	1	I.C., MC14001BCP	U1	
2860 0359	1	I.C., MC14012BCP	U2	
2870 0104	6	TRANSISTOR, TIS97	Q1-6	
3001 0043	1	RELAY DPDT	K1	

5.9 Chassis/Front Panel

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
0710 0017	1	Microphone		50K Ohm Ceramic
0710 0020	1	Speaker, 3.2 ohm	LS1	
1400 0000	1	Cable, assy	P1	
1400 0001	2	Cable, assy	P2A,P3A	To A6 board
1400 0007	2	Cable, assy	P2,3	3.6" length
1420 0006	1	Fuseholder	XF1	
1440 0053	7	DIP lock fastener		
1900 0023	1	LED, yellow	CR2	Part of front panel
1900 0024	1	LED, green	CR1	Part of front panel
1900 0025	2	LED, red	CR3,4	Part of front panel
2700 0017	1	Pot, 10K and switch	R2/S2	Squelch and Hi-Lo Pwr. Sw.
2700 0018	1	Pot, 10K and switch	R1/S1	Volume and on/off control
2810 0189	1	Diode, 1N5400	CR5	
2850 0106	1	I.C., LM309	U1	
3002 0004	1	Fuse, 6 amp	F1	fast blow only
5030 0322	2	Hexnut, thin		
5030 0333	4	Nut, 4-40 acorn		
5115 7216	1	Shield, A1		
5115 7441	1	Shield, A5		
5115 7460	8	Washer, foam		
5515 6834	1	Front frame		
5515 6854	1	Knob, volume		
5515 6855	1	Knob, squelch		
5515 7816	1	Lens, yellow		Part of front panel
5515 7367	1	Grille cloth		Part of front panel

5.9 Chassis/Front Panel

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
5315 7398	1	Number set		
9115 6853	1	Base assembly		
9115 7193	1	Front panel assembly		
9115 7215	1	Cover assembly		
1430 5008	1	Power receptacle, w/ears 6 pin		
1430 5009	6	Pins		
1430 5021	12	Remote sockets		
1430 5047	1	Remote connector, w/ears 12 conductors		

6. MARINER 9 REMOTE CONTROL.

6.1 Introduction.

The Mariner 9 Remote Control Unit duplicates all the controls and functions of the Mariner 90R VHF Radiotelephone at a location separated from the main unit. Up to 100 feet of separation between units is possible.

For the Mariner 9B, see Section 6.3.1.

6.2 Specifications.

Operating Temperature Range . . . . -20°C to +50°C

Humidity. . . . . .90% @ 50°C 8 hrs.

Shock . . . . .EIA RS-204A

Vibration .EIA RS-204A

Size. 10-3/4"W x 4"H x 8"D

Weight. 3.5 lbs./1.6 kg.

Speaker . . . . 3.2 ohm

Audio Power Output. . . . . 4 watts @ 10% distortion

Supply Voltage. 13.6V ±10%

Supply Current (from main unit, average voice). . . . .1 amp

6.3 Available Options.

The following options are available for the Mariner 9:

- Custom PROM (U10, A1 board)
- H-177 Handset
- External Speaker
- Additional Remote Control Cable

6.3.1 Custom PROM.

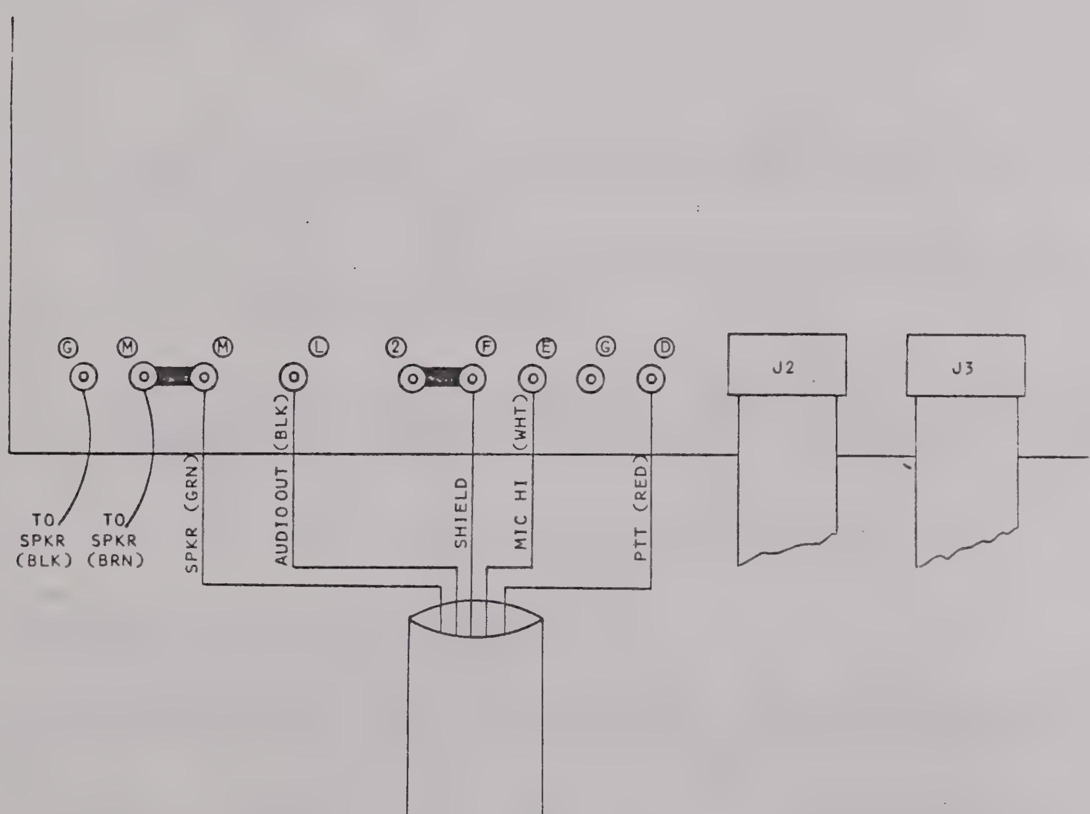
A custom PROM is available to

- change accessibility to channel frequencies
- inhibit transmit on any number of channels
- preset transmit power to LO power only on any number of channels.

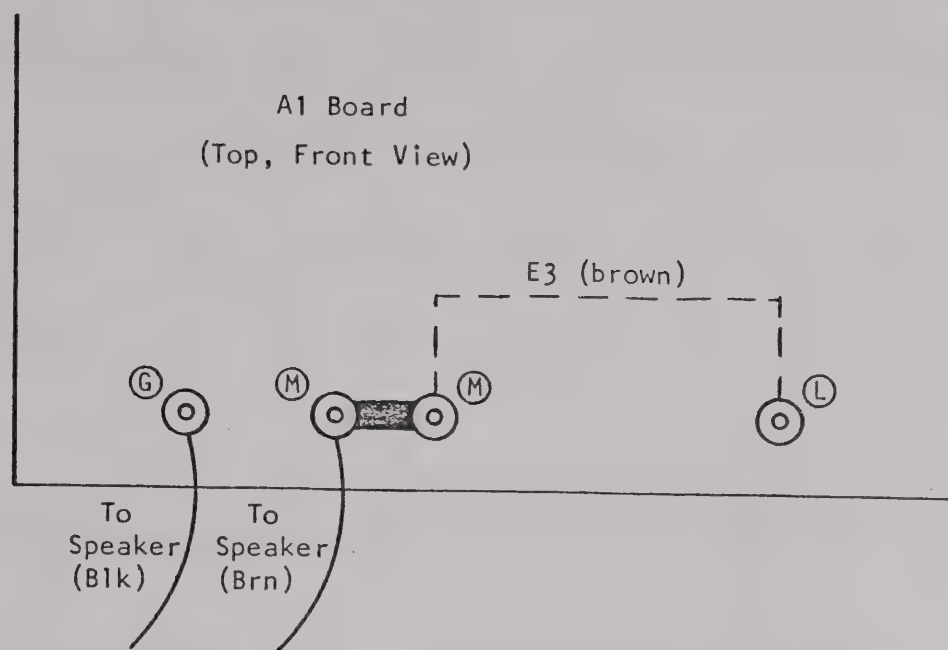
With a diode inserted in the internal information matrix (A1 board) position B and a custom PROM (Intech P/N 2860 0234) installed, the remote control is designated Mariner 9B. The Mariner 9B is intended for use by the merchant marine and has the approval of the ARA. For further details, consult the factory.

6.3.2 H-177 Handset.

An H-177 Handset may be connected as shown below.



6.2.3 External Speaker.



1) To connect the external speaker in parallel with the internal speaker, connect the external speaker between pin L and pin G on the A1 board.

   NOTE: EXTERNAL SPEAKER MUST BE 16 OHM OR MORE TO AVOID DAMAGE TO THE AUDIO AMPLIFIER.

2) To connect the external speaker in series with the internal speaker, remove jumper E3 (brown). Connect the external speaker between pin L and pin M essentially replacing E3 with the external speaker.

   For best results, use low impedance (3 ohm) speaker.

6.2.4 Additional Remote Control Cable.

Figure 26 shows the remote cable assembly. For an extra 20 foot length, specify Intech P/N 9115 7823. For any other length, consult the factory.

6.4 Check Out.

Installation of the Mariner 9 is described in the Mariner 9 Owner's and Installation Manual. After installing the Mariner 9, a check-out should be performed to ensure that the unit operates properly. It is in the following assumed that the Mariner 90R is operating correctly and that the Mariner 9 is connected to the Mariner 90R with the appropriate cable assembly (Intech P/N 9115 7823).

Start with both the Mariner 90R and the Mariner 9 turned off. Then perform the check as follows:

- Turn the volume control knob clockwise to power ON position.
- The Mariner 9 should not be in control. Press E key to gain control.
- Select an inactive channel.
- Turn squelch control knob fully clockwise and then counterclockwise until receiver noise through the loudspeaker stops. Pull out squelch control knob for 1 watt RF power output. Check the LO PWR light.
- Select a weather channel or other known operating channel and check that reception is clear and undisturbed.
- Select an active transmit channel. Key the microphone and check the TX PWR light.
- Push-in squelch control knob for 25 watt RF power output.
- Select a local public correspondence channel. Call marine operator and ask for a radio check.
- If private channels have been installed in the Mariner 90R, check that the display shows the correct private channel entered. For example, if private channel P3 has been "loaded", check as follows:

  First press P
  then press 3
  then press E (enter)

  DISPLAY MUST SHOW P3

NOTE: If the private channel option has not been installed or if a private channel has not been programmed into the private channel board, the display will show PE (private channel empty) for approximately 1 second - then return to previous selected channel.

If the private channel is programmed for transmit, also check TX PWR light by keying microphone - in high as well as low power.

6.4 --Continued.

- When using the H-177 handset instead of the standard microphone, perform check by calling marine operator for a radio check.

  Also verify that audio is transferred from the H-177 handset to the Mariner 9 when the handset is returned to the cradle.

- If a custom PROM has been installed, check the status (simplex/duplex, TX OK/NOT OK, etc.) of any channel that differs from the channel in the Mariner 90R.

6.5 Theory of Operation.

Operation of the Mariner 9 remote control unit is illustrated by the block diagram, Figure 22 and the schematic of the Mariner 9, A1 board (Figure 23). The operation is best explained by referring to the Mariner 90R, A7 board (Figure 19) in relation to the Mariner 9, A1 board since control data is routed back and forth between these two boards via the remote cable. Since the Mariner 9, A1 board is very similar to the Mariner 90R, A7 board, see also Section 3.7

The channel selector, channel indicator and microprocessor circuitry is the same as that used in the Mariner 90/90R. For a detailed description of this circuitry, see the description of the A5 board, Section 3.5. In the Mariner 9 (see Figure 23), the synthesizer code put out by the microprocessor controls the initialization circuit (U11) and status PROM (U10) in a fashion very similar to the way control takes place in the Mariner 90/90R (A4 board, Section 3.5). The only major difference is in the initialization matrix where additional information is required. If a private channel is to be accessible or if transmit must be inhibited on this particular private channel in the Mariner 9, then a diode must be inserted in the appropriate position (see Figure 27).

The microprocessor outputs a digital code whenever a display change (channel number or status) takes place. This code is buffered and amplified in the line driver Q4, Q5 before being fed to the Mariner 90R. A similar line driver is located on the Mariner 90R, A7 board (Figure 19). The digital code received from the Mariner 90R is received and buffered in the line receiver, U9 before being applied to the data input port of the microprocessor. The same signal is inverted in Q6 and applied to the external interrupt port of the microprocessor. A similar line receiver is located on the Mariner 90R, A7 board (Figure 19).

Transmit audio from the microphone is buffered in U6 before being routed to the Mariner 90R. The audio is superimposed upon a DC voltage of approximately 6V when the microphone is keyed. When the microphone is unkeyed, the output voltage (U6, pin 6) is approximately 1.4V.

The DC level change is done be changing the bias input voltage to U6 (pin 3). When keyed, U4A, pin 1 is approximately 5V DC and the voltage on U6, pin 3 and thus pin 6 is approximately 6V DC due to the voltage divider R36, R30. When not keyed, U4A, pin 1 is approximately 0V DC and U6, pin 3 and thus pin 6 is approximately 1.4V DC.

6.5 --Continued.

The DC level change to approximately 6V when keying the microphone serves to activate several switches on the intercom hi line (wire number 1). In the Mariner 9, Q3 is turned on to stop priority scan. In the Mariner 90R, Q4 (priority diode switch), Q3 (squelch inhibit switch), and Q6 (intercom clamp) are turned on to stop priority scan, inhbiit squelch action and clamp the noise output of the discriminator respectively (Figure 19).

The audio/noise input on wire number 7 (receive intercom audio) is fed to an audio amplifier and squelch circuit very similar to the circuit described in Section 3.2.

Audio/noise to the volume pot passes a de-emphasis network R59/C20. From the volume pot, the audio is fed to audio power amplifier U8.

Audio/noise to the squelch pot is unde-emphasized and passed to the high pass noise filter, Q2. The filter output is amplified (Q10 and detected (CR2, CR3) to produce a DC voltage. U1A and U1B is a DC amplifier with hysterisis (trigger) that controls the audio switch, U1E. With only noise present in the receiver, U1E is turned on and the noise is prevented from reaching the audio amplifier.

The squelch information is also routed to the microprocessor via U1C, U1D and U12.

U1F serves to mute the audio amplifier when the microphone is keyed. U1F is controlled by U4B which is directly connected to the PTT switch.

6.6 Maintenance.

Testing and troubleshooting the Mariner 9 can to a certain extent be done without the Mariner 90R. To assure a complete working system, though, the Mariner 90R should be connected while checking.

Since the A5 board in the Mariner 9 is identical to the Mariner 90R A5 board, see Section 4.2.4 and Section 4.3.5 for test and troubleshooting information.

For testing and troubleshooting the Mariner 9 A1 board, compare to test and troubleshooting of the Mariner 90R A7 board (Section 4.3.7). The two boards have a lot of circuitry in common.

- SUPPLY VOLTAGE:

  If the Mariner 9 is tested without the Mariner 90R, 13.6V supply must be applied between pin 12 (+) and pin 6 (-). Measuring the voltage on U7, pin 1 will check the 5V regulator.

  If the Mariner 9 and the Mariner 90R are tested as a system, the supply voltage is supplied by the Mariner 90R. In addition, the checking U7, pin 1 the voltage should also be measured on terminal A and B to assure that the voltage drop thorugh the cable and connector is not exessive (<.5V).

- REMOTE LIGHT, HI/LO POWER:

  If the remote light is on after activating the E key, check U3D, pin 10. If OK, the problem is most likely on the A5 board. If not O.K., the problem can be U3 or U10.

  Hi/lo power problems usually show up as a failure to obtain hi power. Again, U3 is the problem. If the Mariner 9 is in control (U3D, pin 10 low level) and U3A, pin 4 is low, U3B, pin B and therefore terminal W must be high in order to control the hi/lo power switching on the Mariner 90R A4 board.

- INITIALIZATION:

  Testing the initialization matrix is rather difficult since the matrix is used mainly following the turn on of the supply voltage. Problems are easily recognized, though. Wrong scan speed and/or wrong squelch drop-out time is an initialization matrix problem. Likewise, if scan, search, priority or weather channel accessibility is different than programmed, the initialization matrix and associate circuitry is the problem. Before replacing U11, assure that U2D is operating correctly and that CR8, CR9 and any diode in the matrix is O.K.

- DATA BUS:

  A problem in the data bus can be detected by monitoring terminal 10 and test point B with an oscilloscope and pressing the E key to transmit data. (For continuous transmission of data, load one channel into scan and start scan.)

  Signals at terminals 10 and test point B must be identical.

  Problems in U9 are more difficult to detect and require the operation of the Mariner 9 with a Mariner 90R. The Mariner 90R must transmit data (for example, scan one channel as described above). Measure the signal on terminal 10 and test point A with an oscilloscope. They must be identical.

- TX, RX AUDIO AND INTERCOM:

  To troubleshoot the operation of the Tx audio/intercom driver U4A, U6, set up equipment for transmitter check hi/lo power per 4.2.2. Key the transmitter and talk or whistle into microphone. Monitor terminal 1 and terminal E alternately with an oscilloscope and check that the audio levels are identical. While keying the microphone on and off, check that the DC output level on terminal 1 alternates between approximately 1.4V and 6V.

  If no DC voltage change is observed, check U4A, pin 1. If correct output is observed on U4A, pin 1, U6 is faulty.

  Problems with transmit muting can be traced by monitoring the DC voltage on U4B, pin 13 while keying the microphone on and off. The DC level should be high in the Tx mode (causing U1F to be turned on) and low in the Rx mode. Performing the same test while monitoring terminal 3 checks the PTT circuitry. Make sure that Tx is O.K. on the particular channel used for this test.

- AUDIO AMPLIFIER AND SQUELCH:

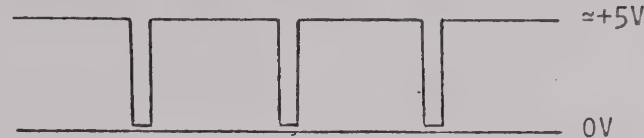
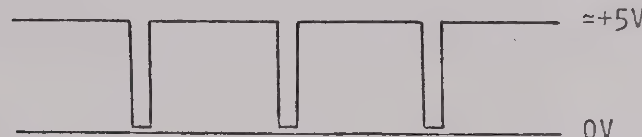
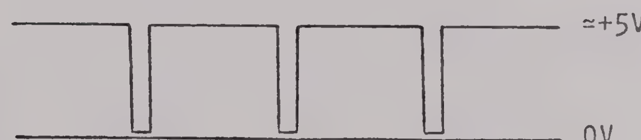
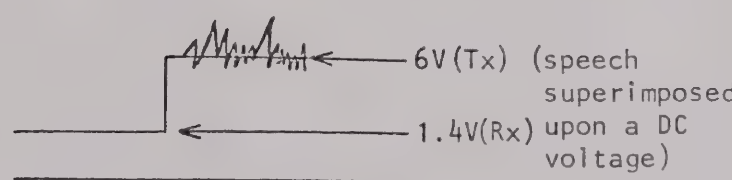
  Problems in the audio and squelch circuitry can be found by checking test points C through H.

  In the unsquelched mode, noise is present at the "high" side of the volume and squelch potentiometer. With the squelch pot completely counterclockwise, there is about 3V p-p noise at the collector of Q1. Squelching the receiver results in U1B collector going high, therefore U1E turns on and shorts the input of U8 to ground.

  Test points G and H serve to locate problems in the audio power amplifier, U8. To assure that problems are actually in the audio amplifier, disconnect the speaker (terminal L) and check audio output test point H.

MARINER 9, A1

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
U7, pin 1	Regulated 5V DC	4.8 - 5.2V DC
U3D, pin 10	Remote light	M9 in control: low level M90R in control: high level
Terminal W	Hi/lo power control	M9 in control: high level M90R in control: low level
Terminal 10	Data buss	
Test point B	Data out from microprocessor	
Test point A	Data input to microprocessor	
Terminal 1	Tx audio output	
U4A, pin 1	"Tone" switch	Mic keyed: high level Mic unkeyed: low level
U4B, pin 13	Transmit muting	Same as U4A, pin 1

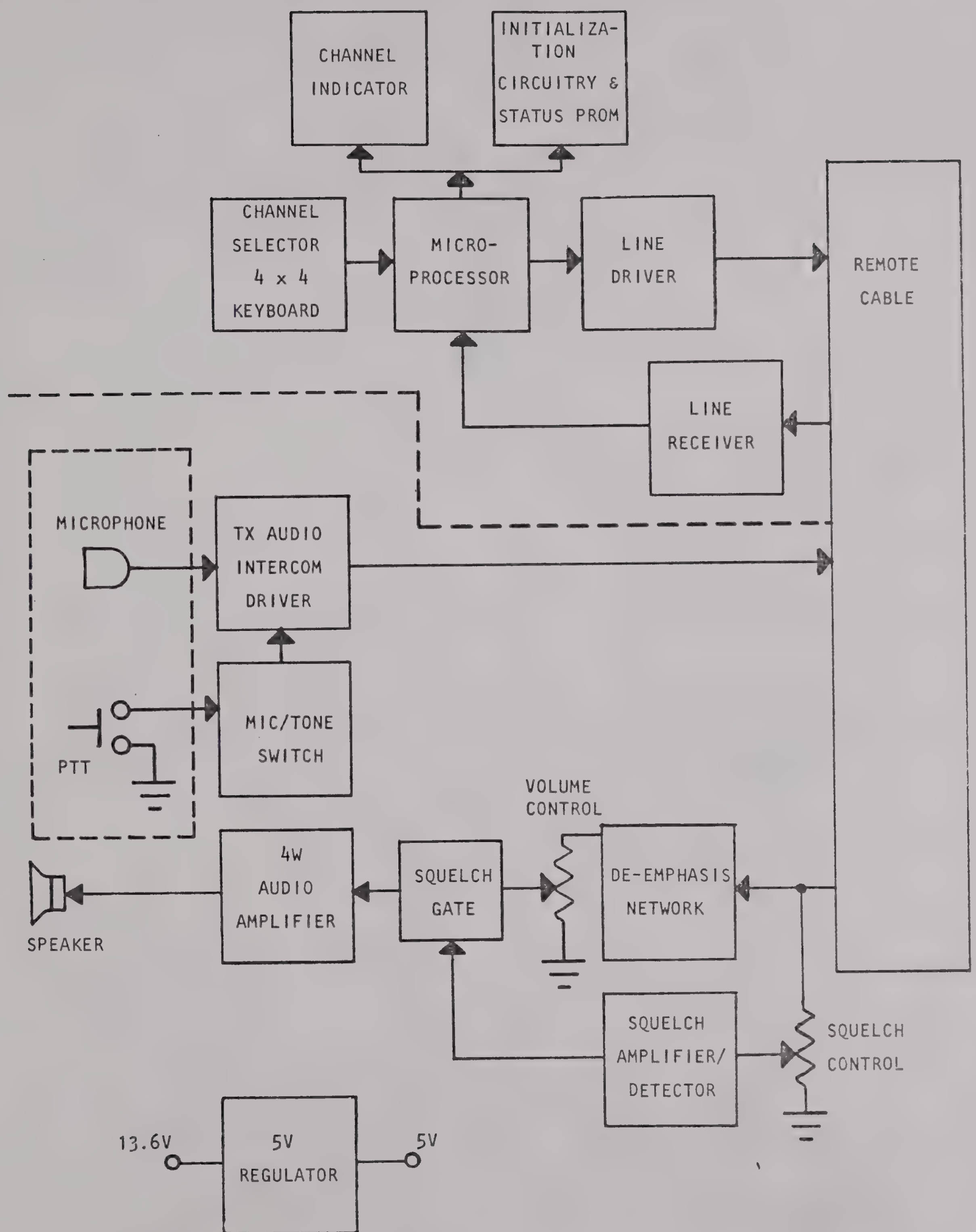
MARINER 9, A1 (Cont.)

TEST POINT VALUES

TEST POINT	FUNCTION	DESCRIPTION, VOLTAGE
Terminal 3	PTT to M90R	Same as U4A, pin 1
C	Squelch filter	3.3V DC
D	Squelch amp	4.2V DC, no squelch (CW)
E	Noise detector	0V, unsquelched (CW) 3V, max. squelch noise (CCW)
F	Squelch DC amp	0V, unsquelched 9.2V, squelched
G	U8, bias	6.8V DC, pin 7
H	U8, output	6.8V DC, pin 12

FIGURE 22

MARINER 9 BLOCK DIAGRAM



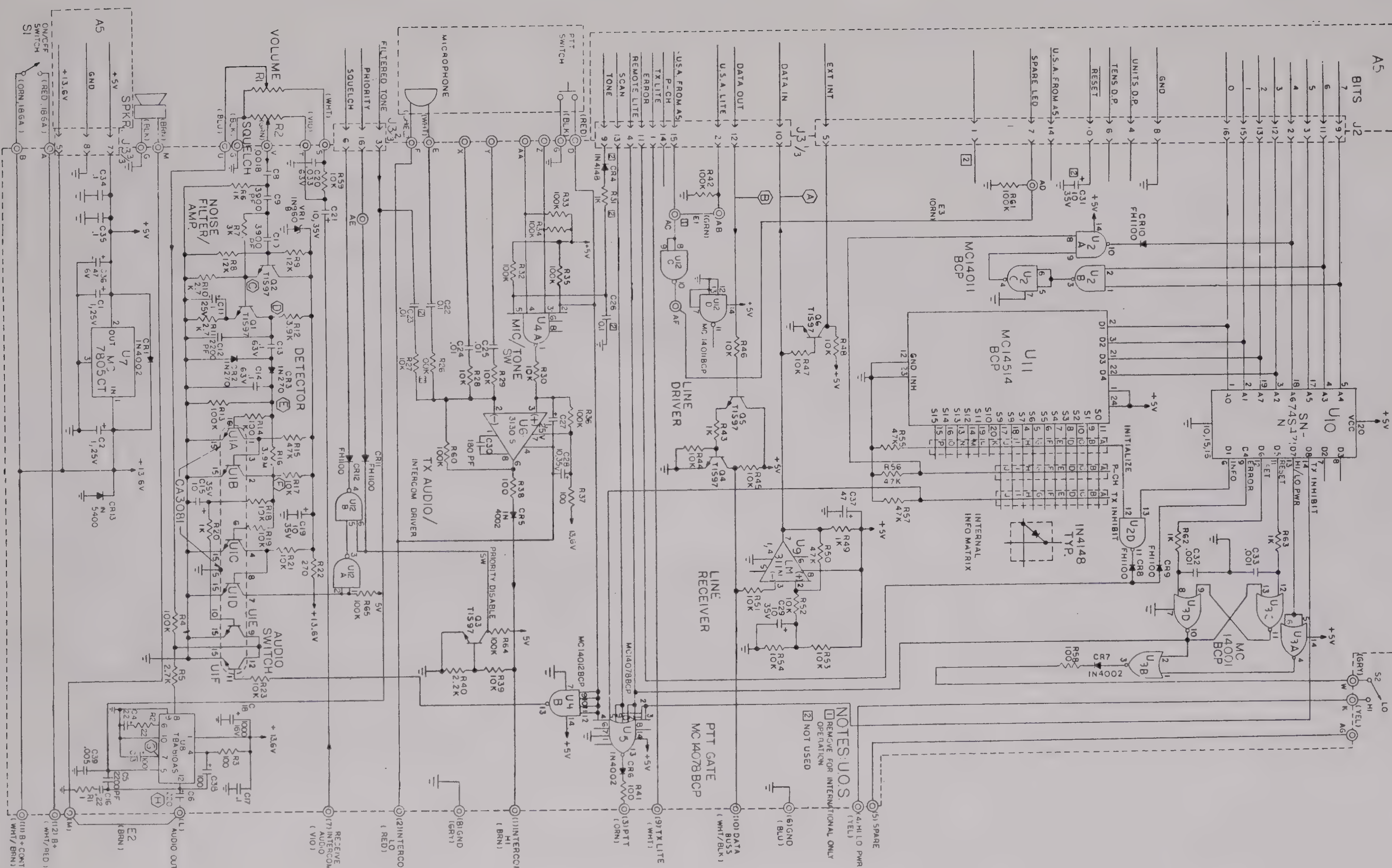


FIGURE 23
MARINER 9, A1 REMOTE SCHEMATIC

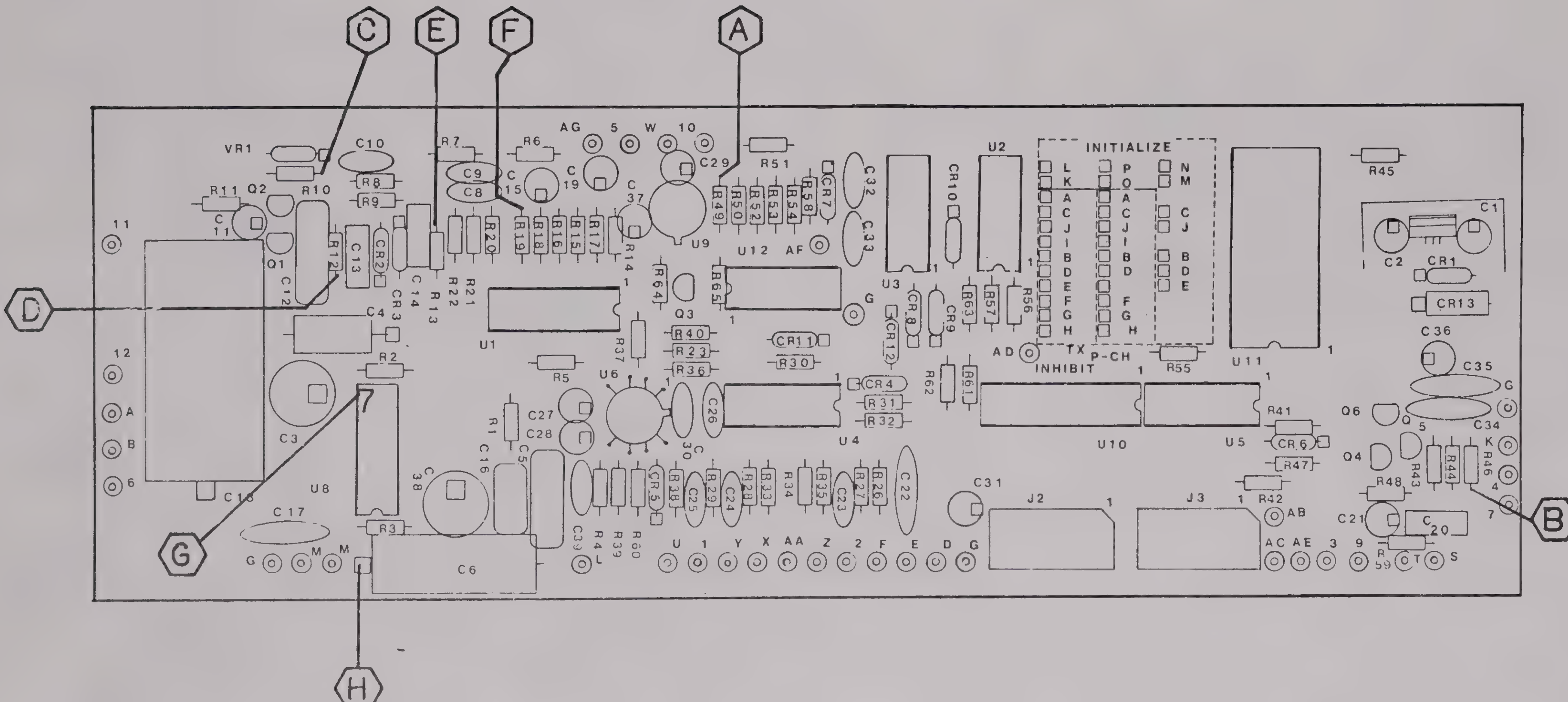


FIGURE 24

MARINER 9, A1 REMOTE COMPONENT LOCATIONS

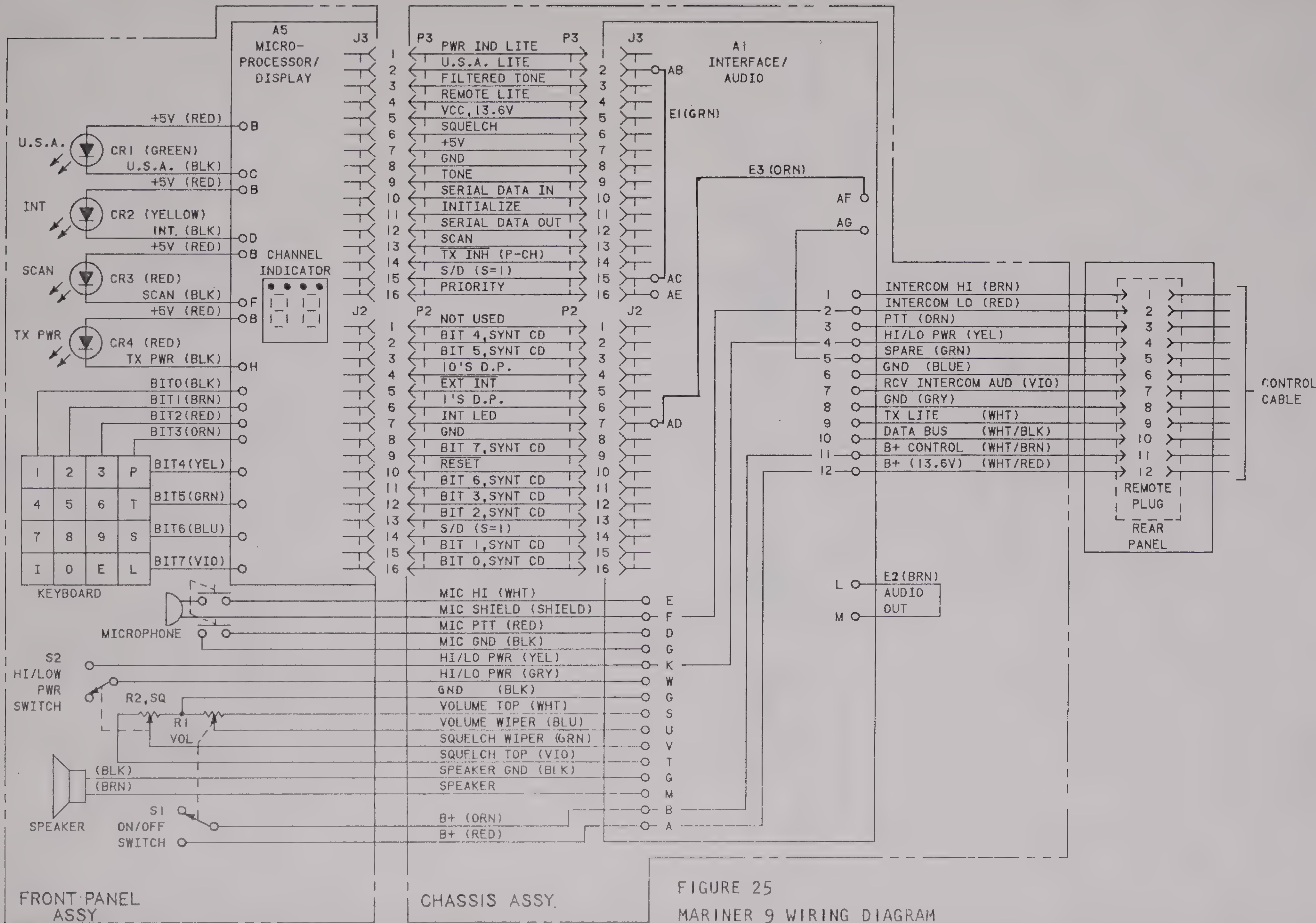
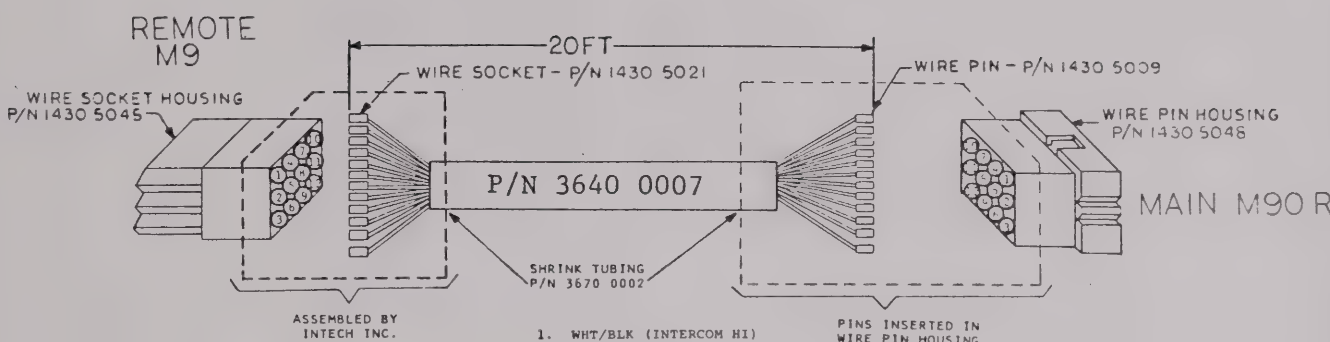


FIGURE 25
MARINER 9 WIRING DIAGRAM

FIGURE 26

MARINER 9 REMOTE CABLE

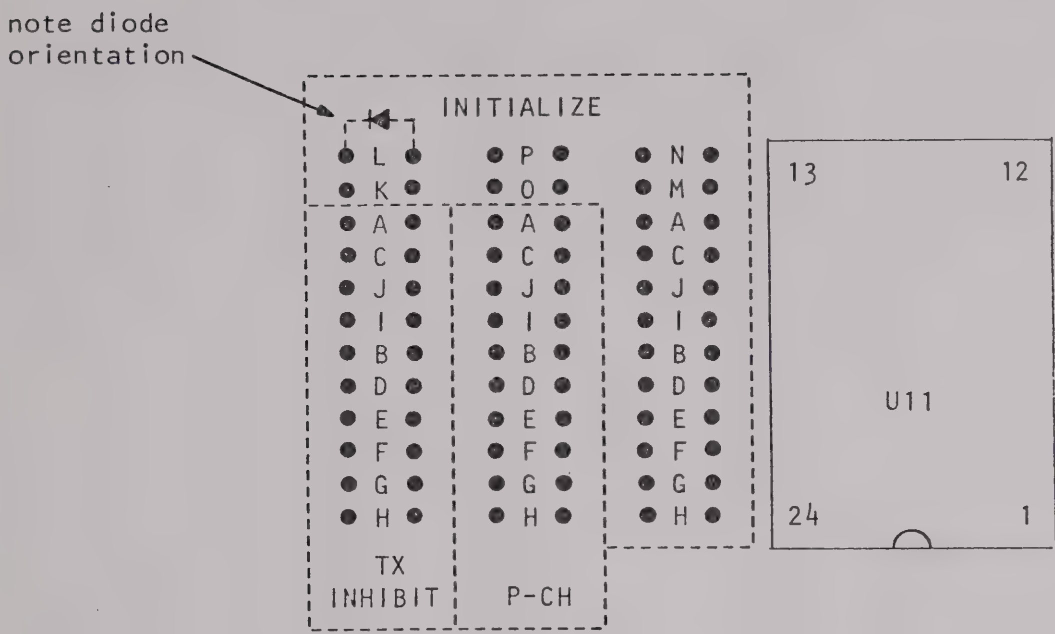
(9115 7823)



1. WHT/BLK (INTERCOM HI)
2. RED (INTERCOM LO)
3. ORN (PTT)
4. WHT/RED (HI/LO PWR)
5. GRN (SPARE)
6. BLU, BLU/RED, BLU/BLK & BLU/WHT (GND)
7. ORN/BLK (RECEIVE INTERCOM AUDIO)
8. BLK/WHT, BLK/RED, GRN/BLK & GRN/WHT (GND)
9. WHT (TX LITE)
10. BLK (DATA BUSS)
11. ORN/RED (B+ CONTROL)
12. RED/BLK, RED/WHT & RED/GRN (B+)

FIGURE 27

MARINER 9, A1 BOARD INITIALIZATION MATRIX



INTERNAL INFORMATION MATRIX	P-CHANNEL	TX INHIBIT
A NOT USED	P0	P0
B WO-9 OK/NOT OK	P1	P1
C SCAN OK/NOT OK	P2	P2
D SEARCH OK/NOT OK	P3	P3
E PRIORITY OK/NOT OK	P4	P4
F NOT USED	P5	P5
G NOT USED	P6	P6
H NOT USED	P7	P7
I NOT USED	P8	P8
J SCAN SPEED 10CH/S*	P9	P9
K SCAN SPEED 6CH/S*		
L SCAN SPEED 4CH/S*		
M SQUELCH DROP-OUT NATURAL		
N SQUELCH DROP-OUT 1.4S*		
O SQUELCH DROP-OUT 2.6S*		
P SQUELCH DROP-OUT 3.2S*		

* ONE DIODE PER FUNCTION

LIST OF COMPONENTS

6.7.1 Remote Control, A1 (9115 7766)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1008 0035	1	CAP., 180PF	C30	
1008 0047	2	CAP., .001µF	C32,33	
1008 0049	1	CAP., .0018µF	C8	
1008 0055	2	CAP., .01µF	C24,25	
1008 0061	4	CAP., .1µF	C17,22,34,35	
1008 0065	1	CAP., .005µF	C39	
1008 0072	2	CAP., 3900PF	C9,10	
1012 0005	1	CAP., 22µF, 25V	C4	
1012 0009	1	CAP., 220µF, 16V	C6	
1012 0012	1	CAP., 1000µF, 16V	C18	
1012 1016	2	CAP., 100µF, 16V	C3,38	
1024 0168	2	CAP., 2200PF	C5,12	
1028 0263	1	CAP., .033µF, 63V	C20	
1028 0265	1	CAP., .22µF	C16	
1028 0266	2	CAP., .1µF, 63V	C13,14	
1044 0300	5	CAP., 10µF, 35V	C15,19,21,28,29	
1044 0302	2	CAP., 47µF, 6V	C36,37	
1044 0303	4	CAP., 1µF, 25V	C1,2,11,27	
1440 0055	2	CONNECTOR, 16 PIN	J2,3	
1440 0068	1	SOCKET, 20 PIN	XU10	
2810 0104	5	DIODE, FH1100	CR8-12	
2810 0105	1	DIODE, ZENER 1N960B	VR1	
2810 0117	2	DIODE, 1N270	CR2,3	
2810 0189	1	DIODE, 1N5400	CR13	
2810 0232	4	DIODE, 1N4002	CR1,5-7	
2850 0156	1	I.C., LM311H	U9	
2850 0178	1	I.C., TBA810AS	U8	
2850 0239	1	I.C., CA3130S	U6	
2850 0286	1	I.C., MC7805C5	U7	
2850 0289	1	I.C., CA3081	U1	

LIST OF COMPONENTS

6.7.1 Remote Control, A1 (9115 7766)

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
2860 0233	1	I.C., SN74S471N	U10	
2860 0173	1	I.C., MC14001BCP	U3	
2860 0175	2	I.C., MC14011BCP	U2,12	
2860 0350	1	I.C., MC14514BCP	U11	
2860 0352	1	I.C., MC14078BCP	U5	
2860 0359	1	I.C., MC14012BCP	U4	
2870 0104	6	TRANSISTOR, TIS97	Q1-6	
5101 0156	1	HEATSINK	XU7	
5115 7271	1	HEATSINK	XU8	

6.7.2 Chassis/Front Panel

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
0710 0017	1	Microphone		50K Ohm Ceramic
0710 0020	1	Speaker, 3.2 ohm	LS1	
1400 0001	2	Cable, assy	P2A,P3A	To A6 board
1400 0C07	2	Cable, assy	P2,3	
1440 0053	7	DIP lock fastener		
1900 0023	1	LED, yellow	CR2	Part of front panel
1900 0024	1	LED, green	CR1	Part of front panel
1900 0025	2	LED, red	CR3,4	Part of front panel
2700 0017	1	Pot, 10K and switch	R2/S2	Squelch and Hi-Lo Pwr. Sw.
2700 0018	1	Pot, 10K and switch	R1/S1	Volume and on/off control
2810 0189	1	Diode, 1N5400	CR5	
2850 0106	1	I.C., LM309	U1	
5030 0322	2	Hexnut, thin		
5030 0333	4	Nut, 4-40 acorn		
5070 0043	8	Headlock		
5115 7441	1	Shield, A5		
5115 7460	8	Washer, foam		
5515 6834	1	Front frame		
5515 6854	1	Knob, volume		
5515 6855	1	Knob, squelch		
5515 7816	1	Lens, yellow		Part of front panel
5515 7367	1	Grille cloth		Part of front panel
5315 7398	1	Number set		
9115 7820	1	Front panel assembly		
9115 7752	1	Cover assembly		

LIST OF COMPONENTS

6.7.2 Chassis/Front Panel

PART NO.	QTY.	DESCRIPTION	REFERENCE DESIGNATOR	REMARKS MFG./SUB.
1430 5009	12	Sockets		
1430 5046	1	Connector w/ears, 12 conductors		
3640 0016	1	Remote cable, 20 wires @ 22 gauge		